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THE COLUMBIA RIVER BAR

THE entrance to the Columbia river lies between a high, rocky headland, Cape Disappointment, on the north and a low sand point, Point Adams, on the south. Joining these two points is the Columbia river bar, which measured along its crest, has had lengths of from 10 to 12 miles. The projection of the bar seaward was 2¾ miles in 1881 and 3⅜ miles in 1902.

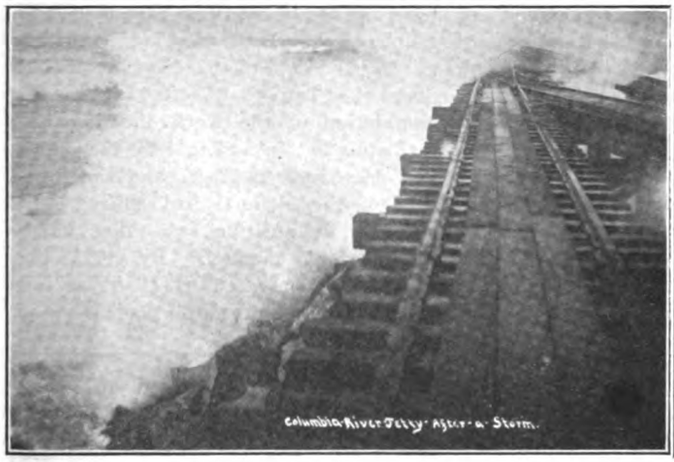
The ocean beach and bed in the vicinity of the Columbia river entrance and the many spits, bars and shoals, both within and without that entrance, are composed of fine sand that is readily shifted from point to point by the prevailing currents, particularly when placed in suspension by the incessant action of the surf on the beach. It is thus molded into configurations that for the time being best indicate the resultant of the forces that lead to sand movements.

The origin of this sand is not susceptible of exact determination. Part of it is due to the slow degradation of the coast cliffs by wave action and other causes, but there appears to be no reasonable doubt that the bulk of it was originally brought from the interior by the Columbia river, which drains an immense area and is the only large stream between Puget Sound and San Francisco. For the greater part of the year the Columbia is not a sediment bearing stream, but during the spring freshets it carries material in suspension and pushes more along the stream. This material forms the bars and the shoals that are found so extensively in the upper river and at the mouth.

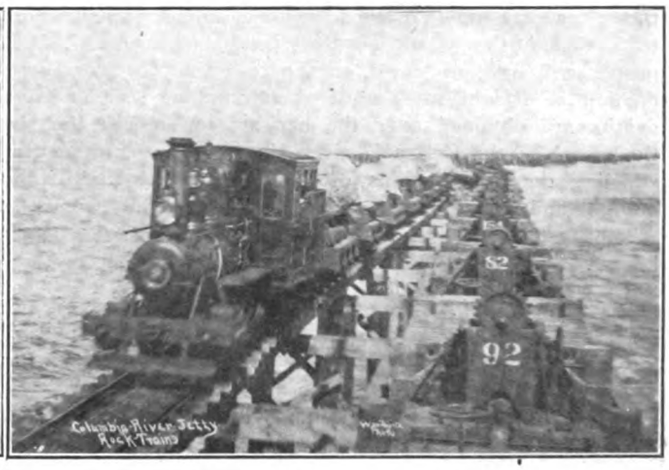
As in the case of all ocean bars the active forces that shape the spits and channels forming the Columbia river entrance are the discharge of the river, the inflow and outflow of the tides and the surf currents that are produced by the winds.

The mouth of the Columbia river is a broad estuary guarded by the bar, which at low water and rough weather is exceedingly turbulent and troublesome. Except during the spring freshets the lower river is rather sluggish and is subject to tidal fluctuations up as far as Portland, Ore., 114 miles from the mouth of the river. The fine sand about the entrance to the bar is readily shifted and causes the instability of the river bars.

The head of deep water navigation



DURING A STORM THE WAVES BREAK OVER THE TRESTLE, MAKING WORK DANGEROUS.



THE ROCK TRAIN ON THE JETTY.

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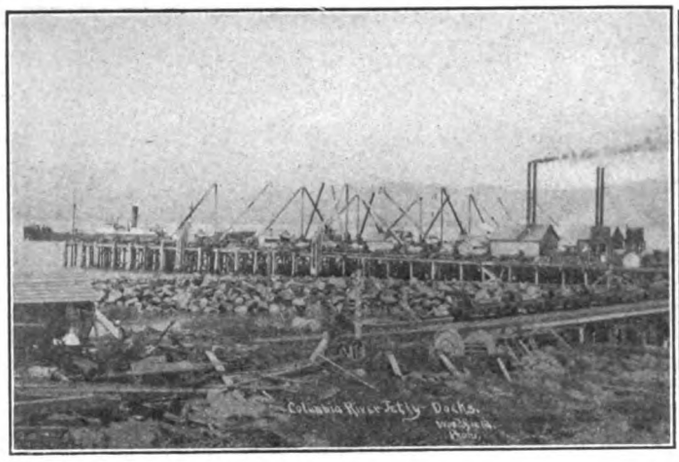


GOVERNMENT DOCKS AT FORT STEARNS, FROM WHICH THE JETTY IS BEING BUILT.

ASTORIA, THE PORT OF ENTRY AT THE MOUTH OF THE COLUMBIA RIVER.

is Portland, Ore. As stated in THE MARINE REVIEW of May, 1909, the city of Portland has probably done more to secure a deep water channel to the sea than any other city of its size. However, the operations have consisted principally in dredging and no part of the work is complete. The maintenance of the channel has been of great advantage to shipping, and there is now no time during the year when a vessel cannot load to a depth of 25 ft. Thus far no permanent work has been completed.

The problem is to secure and maintain on the Columbia river bar entrance a channel 40 ft. deep at the lowest stage of water. Progress on the river has now reached such a state that further work on the river proper will have no effect on the reduction of freight rates until greater depths are obtained over the bar at the mouth of the Columbia river, thus allowing the use of ships of greater draught and carrying capacity.

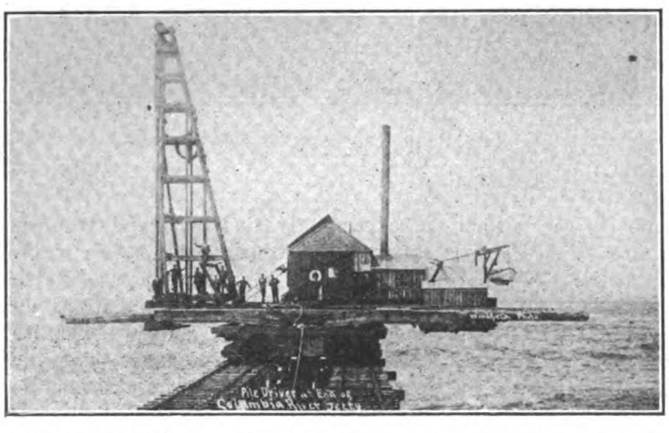
The first project of improving the bar at the mouth of the Columbia river was adopted in 1884, and provided for the construction of a low-tide jetty, 4½ miles in length, extending from Point Adams on the south of the entrance, and terminating at a point about 3 miles south of Cape Disappointment. It was to be built of rubble stone with a foundation of brush mattresses. This project was modified in 1893 to provide for raising the jetty to high-tide, and for building four groins from 500 ft. to 1,000 ft. in length on the north side.

The Columbia river for a considerable part of its total length runs through a rich alluvial soil and many streams feed into it along its course. During the spring and rainy season and when the snows melt on the adjacent mountains, this brings an immense amount of material down in suspension. While the river is narrow and the current swift, it is carried along without any trouble. Down near the mouth the river widens out and at its entrance to the Pacific ocean, the velocity of the current is almost nil at low water and very much slower than in the upper stretches of the river. Here the silt and soil are deposited.

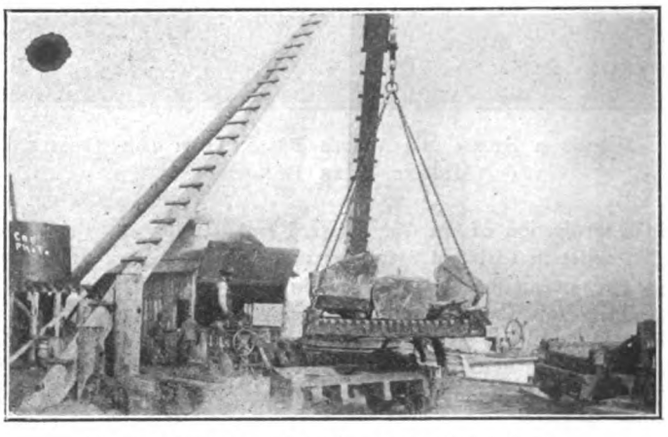
Prior to the commencement of the work of constructing a jetty at the mouth in 1885, there were from one to three channels across the bar. These channels varied from time to time in depth and location. The depths were from 19 to 20 ft. at low water, while the location shifted through nearly 180 deg. between Cape Disappointment and Point Adams.

To obtain accurate data on the river and its fluctuations, a self-registering gage was established at Astoria, in November, 1888, where it was kept in operation until August, 1899, when it was moved to Fort Stevens, where it could be economically maintained.

The original project adopted in 1884 was estimated to cost $3,710,000. Until 1895, $1,968,753 was expended and the jetty completed to a length of 4½ miles, in 1895, and the depth increased over the bar to 31 ft. After the completion of the work shoaling immediately set in and in 1899 the depth had decreased to 28 ft., and the location of the channel had shifted into an unstable position two miles north of the old channel. By 1902 the depth had decreased to 21 ft. at low water. The present project was



THE JETTY DRIVER, EMPLOYED TO SINK THE PILES FOR THE FRAMEWORK, NOW SIX MILES IN THE OCEAN.



HANDLING ROCK FROM BARGE TO ROCK TRAIN.

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started to arrest this shoaling process. It is interesting to note that the first known chart of the entrance to the Columbia river showed the junction of the two inside channels in a single channel running due west into the ocean. The date of this chart is 1792. The survey in 1839 showed a marked change since 1792. The two channels remained unchanged, but each was prolonged to the sea by a separate channel. Great shoals existed between these two channels and the middle sands were submerged at low water in a few places and out of water at many others. After this, Clatsop Spit, so well known in later surveys, began to grow very rapidly and was shoaled over its entire area. After 1881 the north channel continued to deteriorate and by 1885 was practically lost. Clatsop Spit continued to grow in area and lose in height until 1885 when the work of running a jetty across it was started. It then began to grow in elevation, packed as it was by the reinforcement afforded by the jetty.

It was evident at once that the commencement of the construction of the jetty had caused great changes for the benefit of navigation and the position of the river bars. The great middle sands in the mouth of the river have been removed, by the erosive action of the water leaving the channel straight and deep enough for full draught vessels.

The jetty is a long, thin, narrow backbone of material, resting upon a very doubtful foundation against which the action of the forces moving the sands have accumulated large quantities of sand on either side, thus protecting the jetty itself. The permanence and the safety of the present work depend upon the amount of sand that can be gathered together against it.

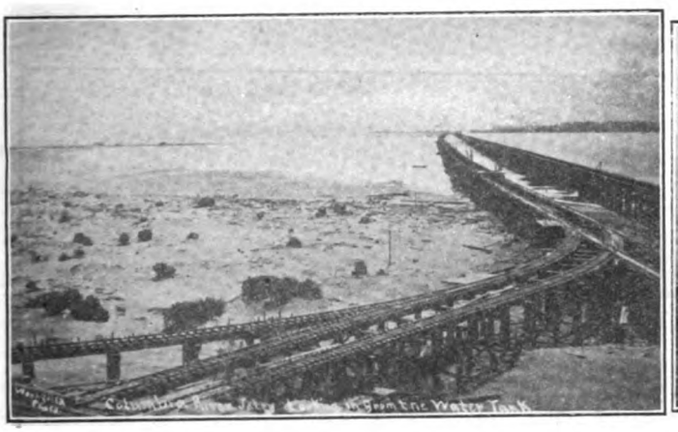
It was seen that the old project of a tide water jetty was not entirely successful and in 1889 the board of engineers recommended that a high level jetty be built. The new work should be extended 2½ miles farther out into the ocean. The first appropriation for the new project was made in 1900. The total estimated cost of the south jetty under the revised plans was $2,260,000, but this has been raised to $3,529,300, and under this final provision the jetty enrockment is being raised to mid-tide level with a crest of not less than 25 ft. to protect the trestle piling from early destruction by the toredo. In some places the jetty is being built in depths of 30 ft. and this makes an increase of 15 ft. in width a considerable addition to the total volume of stone needed.

The final and present construction of this immense engineering work embrace the completion of the south jetty for a distance of 6 miles out into the ocean from Fort Stevens and the erection of a north jetty from Cape Disappointment out some 2½ miles from the end of the present jetty. This will produce a channel about one-half mile in width and when the scouring has been completed, will give a channel 40 ft. in depth. The final completion of this work will give Portland and the Columbia river one of the best ocean harbors of any inland city.

A brief description of the methods employed in building this jetty brings forth some new and interesting methods in construction work of this character. Fort Stevens, the last government post on the south side of the river, is the base of operations for the work on the jetty, which begins at this point. From Fort Stevens the jetty runs in a northwesterly direction for approximately four miles to the end of Clatsop Spit, where a turn is made and the remaining two miles are almost due west, off shore. At Fort Stevens large docks and machine shops have been erected and bunkers and unloading derricks built to handle the rock used in the jetty. Basaltic rock that will resist the action of salt water is used exclusively in this construction. The rock is brought down the Columbia in barges and, in some cases, is transferred to the bunkers at Fort Stevens, but for the most part the rock is only unloaded as needed and is directly loaded on rock trains and taken out on the jetty and dumped.

The frame work of the jetty consists of four rows of piles spaced so that each two rows can be used for narrow gage tracks. The tops of the piles are securely braced and bound together to give stability. Work must necessarily be carried on from the land side, and extended seaward. A number of groins at right angles to the jetty are put in to catch the shifting sand. Between the rows of piles rock is dumped and the work continued until the top is just above mean high tide level. Rock of varying sizes from 1 to 18 tons are used, with the larger sizes at the bottom and the smaller on top.

While this does not present a watertight wall it prevents the littoral offshore currents from moving the shifting sands from place to place. The advance piles are driven by a jetty pile driver and are jettied in place by water pressure. Piles ranging from 80 to 120 feet in length are used. On the driver plant boilers of ample size are used to supply steam to a double act-



SOUTH JETTY AT THE EDGE OF CLATSOP SPIT SAND, LOOKING TOWARD THE OCEAN.

JETTY, LOOKING SEAWARD OVER CLATSOP SPIT

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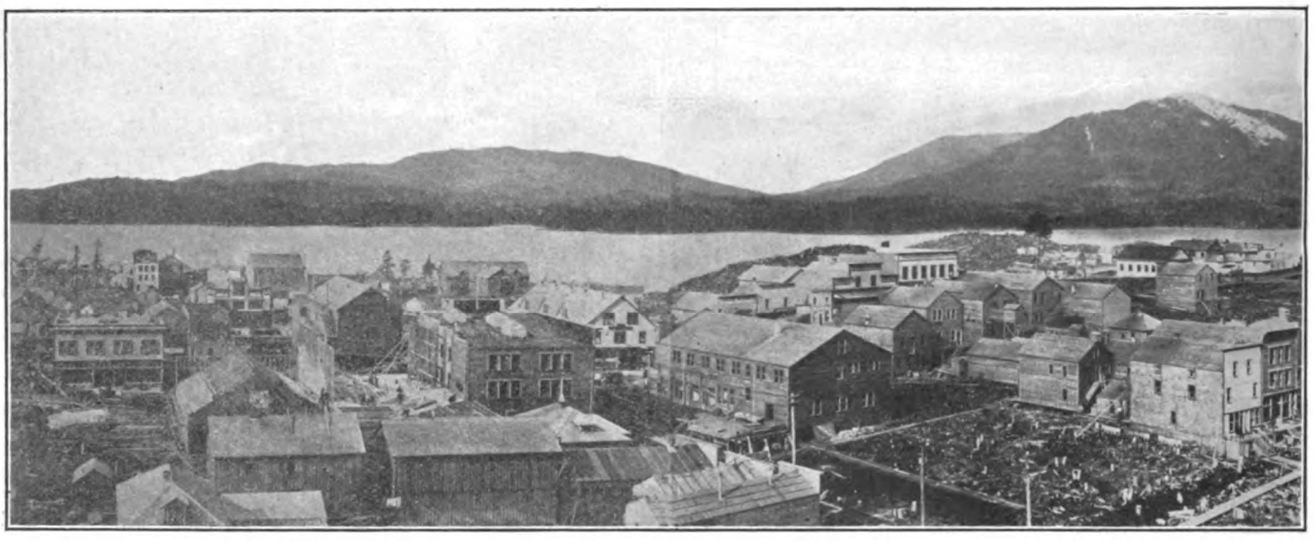
ing duplex pump suspended below the driver. One and one-half in. brass tubes are nailed to the sides of the piles before they are swung into position to be driven and are attached to the delivery of the steam pump. The piles are sunk very much quicker and with more accuracy by the jetty method than by driving only. As soon as possible after the piling has been placed the rock filling is put in position. From December to April of each year, the weather and winter storms are so severe that it is impossible to do any work on the outer end of the jetty. Each winter season causes the destruction of a considerable part of the unprotected outer end. The present jetty is 10 ft. above the datum plane for the first 1⅛ miles from shore. The outer ⅝ of a mile is just about at the datum plane level. It is being gradually flattened down by the action of the water and storms due to its unprotected location.

The work on the Columbia river bar is more in the nature of an experiment than anything else. The action of the ocean, the shifting sands and the river itself are so uncertain that the only method of procedure is to build a part of the work and then study its results, and follow it up with other work as indicated by the results obtained. The project the government engineers are working on is to secure a 40-ft. channel over the bar and to confine the river in such a manner that it will maintain this channel by scouring instead of the very costly method of dredging.

The Columbia river entrance is the only deep-water port in the entire seven hundred miles of stormy coast between San Francisco and the Straits of Fuca at the entrance to Puget Sound. If suitably improved it will be an available harbor of refuge for storm driven ships in distress, when at the present time they are unable to enter, due to the shallow depth and immense breakers driven on the beach during storms. Its value as a commercial port is well known and is further evidenced by the fact that the people of the largest port within the entrance, Portland, have spent $1,000,000 of their own money in the betterment of the channel leading to the harbor.

There is no known plan of improvement that does not include one or two jetties extending continuously seaward from the points of the entrance that are fixed in position naturally or artificially. The turbulence of the bar is such that operations from a floating plant or dredger have never even been considered. Any work of whatever nature must be constructed from a plant built out from shore. All trestle work that may be constructed at any time must be so fully protected by stone backing that in reality it will be merely the continuation of the old trestle and jetty.



PRINCE RUPERT, THE TOWN CREATED BY THE GRAND TRUNK PACIFIC BY SELECTING THE SITE AS ITS PACIFIC COAST TERMINUS.

GRAND TRUNK PACIFIC TERMINALS

SHOWING a progressiveness which more than equals the numerous other great works that were pushed forward in the Pacific northwest by the pioneers of a few years ago, the Grand Trunk Pacific system has acquired and improved a terminal in the United States, at Seattle, far in advance of the transcontinental railway which it is building across Canada. The completion of the railway is at least three years off, but a big wooden structure which serves to forge another link in the chain of commercial and social communications between this country and the dominion is in operation at the foot of Madison street, in Seattle, and ready to handle the water connections along the North Pacific coast for years to come.

The selection of the Canadian terminus on the Pacific coast for the Grand Trunk Pacific railway and its steamship subsidiary was one of the most important tasks of the promoters of this great work. Many things had to be considered. The rail terminus had to have a harbor second to none and be at a place where the rails could reach it without seriously lengthening the line or increasing the gradients. The entire north coast was searched and every harbor sounded before this terminal was select-

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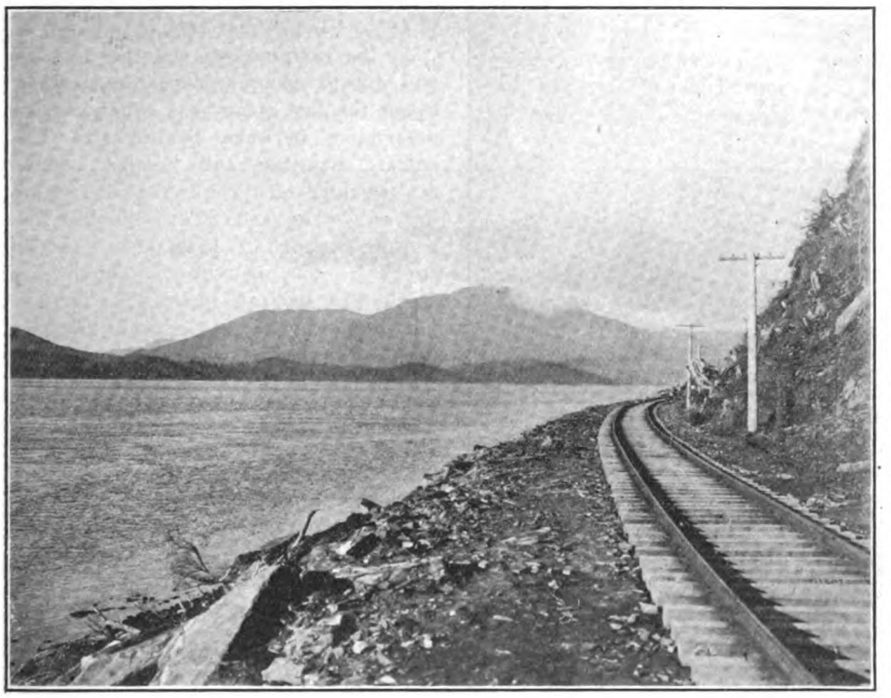
ed, and then the officials fastened upon Prince Rupert, situated 550 miles north of Vancouver and 40 miles south of the Alaska boundary.



GRAND TRUNK PACIFIC TRACK ONE-HALF MILE EAST OF PRINCE RUPERT.

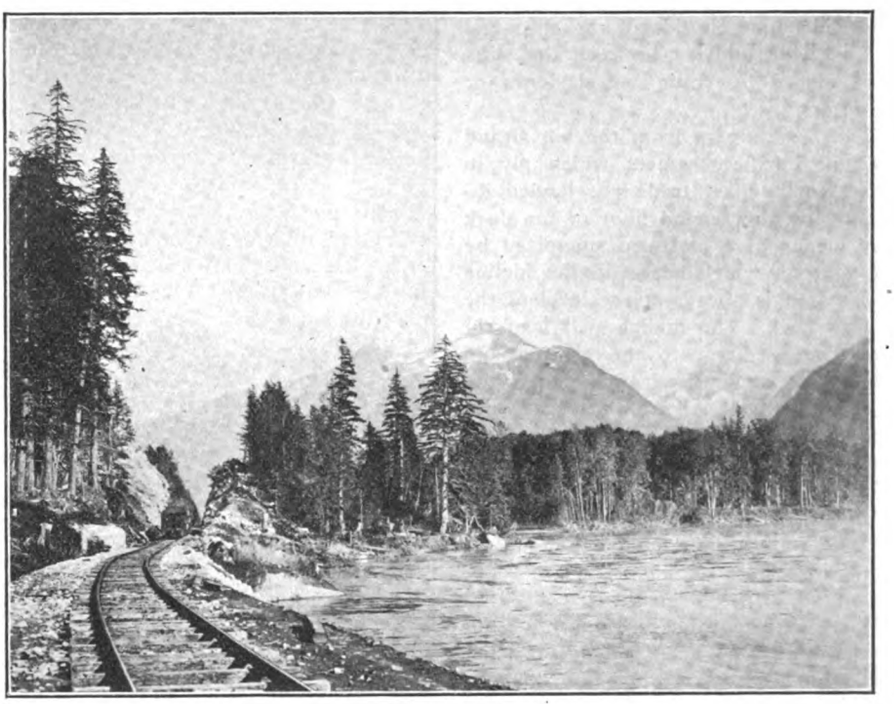
With the western end of the railway fixed and the town started in the building, the problem of selecting the principal terminal for the water lines in the United States was solved by the purchase of centrally located property in Seattle and the beginning of a big dock at which to berth the steamers. The result is that the company probably has the finest wooden structure of its kind completed. As the company will handle passenger business primarily from the pier it is admirably adapted for its intended use and the combination of stores and offices under its roof is a unique feature in structures of this kind, as space has been utilized which heretofore has produced no revenue.

In designing the pier the latest and most modern ideas of wharf construction were embodied and the structure will set the pace for pier building in the northwest. The building is fireproofed to as great a degree as possible considering the style of material used, and a detailed description of the work and the results of the engineers should prove interesting to the wharf builders and maritime men of the country.

The adoption of a design in which wood figured as the only material was due, of course, to the fact that the dock was built on the edge of the greatest timber producing section of the country and that it was the cheapest kind of material. Figures have been brought forward to prove that trussed steel-concrete construction is the most economical in the long run, even in this section, but wood was used nevertheless.

The dock is 625 ft. in length and 120 ft. wide, although an oblique frontage gives it an inshore width of 208 ft. where most of the offices and a warehouse are located. The building is supported by creosoted piles, the specifications for which called for piles to be first growth fir, a minimum of 9 in. in diameter at the tip and 14 in. at the butt, with the penetration of oil fixed at from 1 to 1¾ in. under a 12½ lb. treatment. The length of the bearing piles varied from 55 to 90 ft. with the brace piles running up to 110 ft. in length. The bents were driven 10 ft. apart and the piles spaced along the bents at distances varying from 6 ft. centers to 3 ft. centers at the outer end with clusters of from four to six under posts of trusses where extra loads occur. Brace piles were driven at every bent and in addition the dock is braced both laterally and longitudinally with 4 by 12 in. creosoted bracing. Caps are 12 by 12 in., with stringers 4 by 12 in. spaced 30 in. apart and 12 by 12 in. material under posts and at the sides. The caps are drift bolted to every pile with ¾ by 22-in. drifts and 12 by 12 in. stringers two lines of 10 by 12 in. down the center and every third 4 by 12 in. stringer drift bolted to the caps.

The span of the trusses is 90 ft. and the building is extended on the north side an additional 14 ft., giving warehouse space 104 ft. wide. On the south side of the building there is an 8-ft. space to the edge of the dock and on the north side is a 16½-ft. space where the railroad tracks are located. The dock is equipped with five ad-



CONSTRUCTION WORK ALONG SKEENA RIVER. NO BALLAST HAS BEEN PUT ON TRACK BED AS YET.

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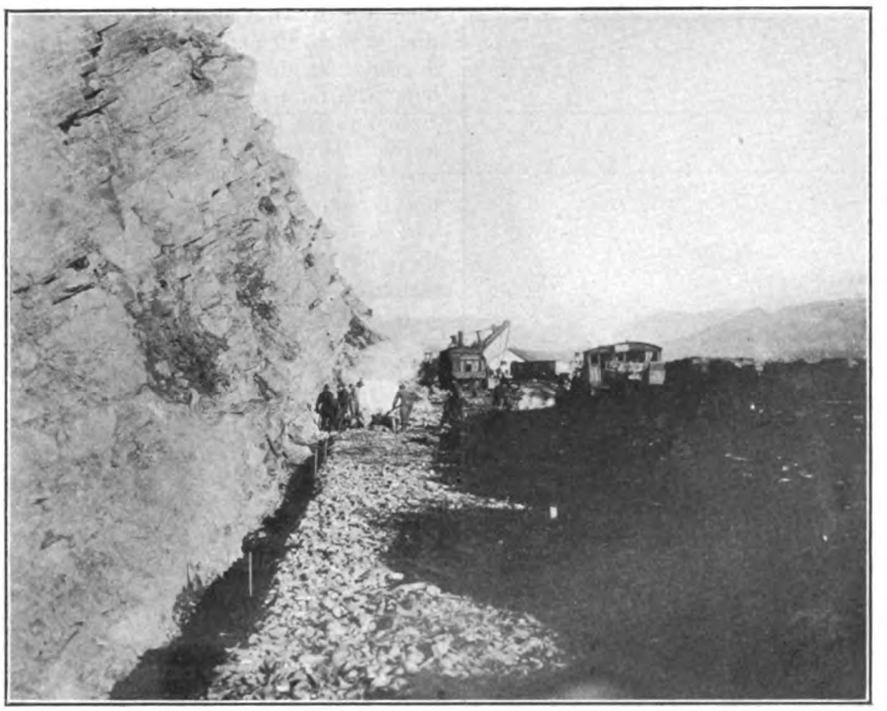
justable loading slips, worked by a worm, with the railroad track carried over those on the north side by Basco bridges. At each slip is located a power plug for use of electric conveyors. The opening in the building, 8 ft. wide on each side of the slips and 14 ft. wide midway between the slips, are closed by rolling steel doors or shutters.



CUTTING AWAY ROCK IN PRINCE RUPERT HARBOR TO FURNISH A PLACE FOR BUILDING WAREHOUSES AND OFFICE BUILDINGS IMMEDIATELY IN THE REAR OF THE GRAND PACIFIC DOCK.

The passengers from the big Grand Trunk Pacific steamers which ply in the North coast trade are landed directly on the second floor of the dock by means of a platform supported by a pontoon which bears up the incline so that it is always at the level of the ship's deck. The incline will lead the passengers direct to the waiting and customs examination rooms and to the over-head walk to the street, which takes the passengers direct to a business avenue and does away with the usual dodging of wagons and freight cars on the water front streets.

The roof of the main warehouse is supported by a diamond truss of 90 ft. span on 12 by 12 pieces spaced 20 ft. apart, with purlins 4 by 10 in. and cross braced between trusses for wind pressure. On the ground floor inshore are six stores with an average floor space of 1,000 sq. ft. each. On the second and third floors inshore are offices and also on the second floor suspended from the trusses down both sides of the warehouse. There is a gallery 10 ft. wide in front of these offices, leaving an open well 30 ft. wide, over the main floor. The total number of offices in the building is 69. In addition on the sea end there is a tower 20 by 20 ft. and 106 ft. high above the first deck has been built in which are four offices especially suitable for harbor officials because of the fine view of the port.

At the extreme sea end the dock is laid out to accommodate the steamer Flyer, the fast steamboat which carries passengers between Seattle and Tacoma. Baggage and bonded rooms are provided on the lower deck and on the second floor level are situated the waiting rooms, ticket office, parcel check room, restaurant, which are reached by separate inclines for incoming and outgoing passengers. A gallery for a band stand overlooks the waiting room and a stairway leads to the open air promenade and roof garden at the sea end.

Counting out the space allotted to offices, boiler and fuel rooms and a 30 by 25 ft. garage the deckage available for the handling of freight is about 440 by 104 ft. There are firewalls distributed freely through the dock in which the openings are closed by automatic steel shutters. These shutters are of exceptional size, some being 14 ft. wide and 14.8 ft. high with the widest 24 ft. Ship hydrants along both sides every 80 ft., and scattered on the inside of the building, furnish further fire protection.

This terminal of the Grand Trunk Pacific is a splendid monument to the 27-year-old engineer who superintended its construction and had much to

PRINCE RUPERT HARBOR, SHOWING FREIGHTER LYING AT GRAND TRUNK PACIFIC DOCK.

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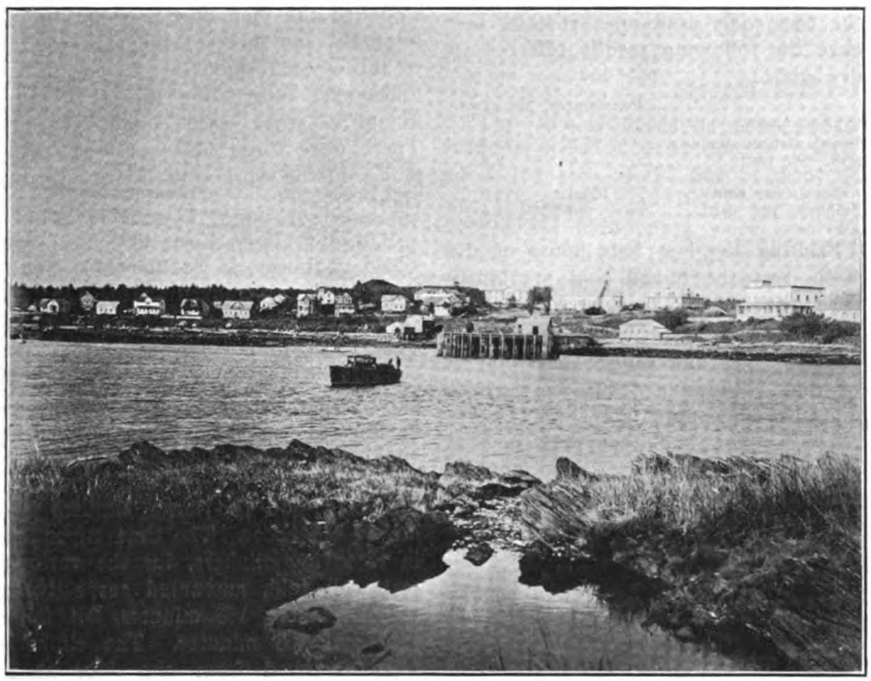
do with its planning. This young engineer is F. T. Lucas, who was born in Hamilton, Ont., in 1883 and educated at the Royal Military college, Kingston, and McGill University, Montreal. Graduating in 1905 he spent one year with the Grand Trunk railway on maintenance of way at Barrie and then came west and joined the Grand Trunk Pacific parties running preliminary lines through the mountains. He was then sent to Prince Rupert to take charge of laying out the townsite as resident engineer in charge of that and the harbor work. From there he was sent to Seattle.



METLAKATLA, FOUR MILES FROM PRINCE RUPERT. IT HAS SPRUNG UP IN THE PAST TWO YEARS AND HAS REGULAR STEAMBOAT SERVICE.

So much for the United States terminal of the Grand Trunk Pacific. Far more important was the selection of the western terminus for the railway in Canada. The harbor was the first thing to be selected. At the outset the subject presented many difficulties, as the British Columbia coast does not possess many favorable harbors. It became necessary for the government and company's engineers to explore and examine the coast line most minutely. The point selected—Prince Rupert—possesses some of the greatest advantages to ocean shipping that can be found along the entire Pacific coast. It has a direct channel passage leading into it of more than a half mile in width and sufficient in extent to accommodate enormous shipping. The seas may be as heavy as only the North Pacific seas can become on the outside but within the protecting snowcaps which enclose the harbor it will be perfectly calm with no seas running at all.

The dominion government hydrographic survey corps has made a complete survey of the harbor and the approaches which shows that from the entrance to the extreme end of the upper harbor, a distance of 14 miles, is entirely free from rocks and obstructions of any kind and is of a sufficient depth to afford good anchorage.

To those familiar with the phenomenal growth of the various other large seaports on the Pacific coast—Seattle, San Francisco, Tacoma, Victoria, Vancouver and Los Angeles and Portland, to say nothing of the lesser but very important ports of Bellingham, Everett, Aberdeen, Grays Harbor, Astoria, San Diego and San Pedro—the possibilities of Prince Rupert are very plain. Seattle, Portland and Tacoma were little more than the smaller places named twenty years ago and today each are an example of what "the coming of the railroad" will do. Before it was named Prince Rupert was the "terminal of a transcontinental railroad" and nothing more but that in itself meant much. Those who have watched the growth of other termini of a "transcontinental railroad" in the Pacific northwest would be the last to say that Prince Rupert will not within the next 15 years be a port to be reckoned with by her older sisters who are fighting for supremacy in the trans-Pacific trade.

The fishing industry alone will be a figure in the port's growth according to the outlook at present. The industry is now in its infancy and yet the salmon pack last year on the Skeena river just south of the harbor and a valuable and important feeder to the commerce of the port was valued at considerably over $1,000,000. The value of these fisheries at the gateway of this harbor cannot be estimated. The pack will undoubtedly be handled mainly over the wharves at Prince Rupert. Those employed will in a majority of cases live at that port and that means freight for the liners and money in the banks.

The timber industry and in fact all industries in the section are naturally in their infancy also. Wharves are being constructed for the handling of the products of the woods and of most importance is a pulp mill which has been established some distance up the coast. Prince Rupert will undoubtedly be a factor in the lumber shipping industry of the west coast before another year has gone by.

Practically before any attempt had been made to lay out the town site the company constructed a wharf 1,500 ft. long which fronts water 26 ft. deep at extreme low tide. This wharf, as shown by the accompanying photograph, is the scene of greatest activity day after day. The Grand Trunk Pacific is operating a regular line of steamers to the port and many other freighters are beginning to come to the harbor for the products of the mountains and fisheries. As soon as the company sees that the wharf will, within a few months, be insufficient to care for the business in prospect it will begin the construction of other and longer wharfs along the edge of the city. As one writer has put it after a visit to the new harbor:

"Prince Rupert is at the end of the long portage on the shortest route around the world. Any scheme which has for its ultimate object the swift circling of the sphere must reckon Prince Rupert on its right-of-way. To this new port will come the ships of the seven seas. Ships of the east, laden with rice and silks, will soon be riding at anchor in this splendid roadway, to sail away laden with lumber; ships from the west with the wares of the west; ships from the shores of far off continents, trading through the new and picturesque port of Prince Rupert."

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EVAPORATIVE TESTS OF MOSHER WATER TUBE BOILERS

THE navy department decided about a year ago to install water tube boilers in the battleships Kearsarge and Kentucky. Official trials of a test boiler, one of 16 to be installed, were recently conducted by George H. Barrus, consulting steam engineer at the Mosher boiler shops, at Ossining, N. Y., under the supervision of the testing board of the bureau of steam engineering of the navy department. The manner of conducting the tests was substantially in accord with the code of rules of the American Society of Mechanical Engineers, the alternate method of starting and stopping being employed. As to the cleaning of the fire in preparation for the close of a test the restriction of the board in this matter made it desirable that this part of the work should be done as expeditiously as possible and for this reason the cleaning was confined simply to the removal of large clinkers. The small clinker and such of the ash and refuse as failed to sift down through the ½-in. air spaces remained on the grates. Mr. Barrus, in his report to the Mosher company, says:

"The coal originally provided was a hand-picked Pocahontas. It purported to be freshly shipped from the mine. On some preliminary tests it was found that the ash in this coal consisted of a slag formation which spread over the grates in a thin layer, and to a considerable extent stopped up the air spaces. It was impossible to remove this slag without cooling off the furnace, and it became almost necessary to abandon the use of the coal altogether. It was found, however, that when a small quantity of the Somerset coal employed in the shop was mixed with it, the slag accumulated about the ash in this coal, making a clinker, which, although troublesome, could be dislodged by slicing, thus largely overcoming the mechanical difficulty noted. A mixture of these two coals was, therefore, employed on the official trials.

"It should be borne in mind that, on account of the excessive clinkering of the coals thus mixed, frequent slicing and removal of clinkers was made necessary, and the coal proved a very unsatisfactory fuel with which to show the capabilities of the boiler.

"Proximate analyses of samples of the two coals used on the 40-lb. test gave the following results referred to dry coal:

	Pocahontas.	Somerset.
Volatile matter, per cent.	20.4	17.4
Fixed carbon, per cent...	77.0	73.7
Ash, per cent.....	2.6	8.9
Total, per cent.....	100.0	100 0
Sulphur, per cent.....	0.6	1.5

"During the last four hours of the 40-lb. test the mixed coal previously used was changed to clear Pocahontas coal, the Somerset coal being omitted.

"The ashes and refuse were limited to that withdrawn from the furnace and ash pit. Soot and other waste from lancing, and that deposited at the base of the stack, were not included. On the 40-lb. test the latter amounted to something over 1 per cent of the weight of the coal consumed.

Method of Firing.

"The method of firing was the alternate side system, with coal spread evenly over the grates, and a regular system of time intervals between firings. The time intervals were five minutes, and the number of shovelsful of coal fired per door at one time varied from two to six, according to the rate of combustion and the requirements of the bed of fuel. On the first test, beginning for example at the even hour 9 o'clock, the first, middle and last doors were fired in rotation, starting at 9. Then there was an interval of two minutes, and the second and fourth doors were fired at 9:02. The next round for the first, middle and last doors began at 9:05, and for the second and fourth at 9:07. The next five-minute firing was omitted and in its place at 9:10 the first, middle and last doors were leveled in rotation, being followed at 9:12 with a leveling of the other two. At 9:15 a round of firings began again, and so on through the entire run. Thus on the first test there were two firings and a leveling at five-minute intervals. On the remaining tests the same method was followed except that the firings occurred every five minutes without exception throughout the run, and leveling was done intermediately after every two rounds.

"The firing force consisted of one fireman and sometimes two, one leveler or slicer, and one door tender. An assistant kept the time by watch, signalled the men at the proper time intervals, and directed the men where to throw each shovelful of coal. The doortender closed the fire door momentarily after each single charge. There were three shifts of men, each being on the work four hours and off eight hours.

"On the 15-lb. test the fire was sliced 12 times. It was barred up, and large clinkers removed twice. On the 25-lb. test, it was sliced 12 times, barred up seven times and the large clinkers removed four times. On the 35-lb. test the fire was sliced and barred up 11 times, and the large clinkers removed six times. On the 40-lb. test, it was sliced and barred up 12 times, and the large clinkers removed six times. The time expended in removing clinkers, for the various tests, all told, amounted respectively to 73 minutes, 168 minutes, 241 minutes and 208 minutes. The clinkers were removed from one door at a time, and one door was wide open for this purpose about two-thirds of the total time given.

"The soot was blown from the lower bafile, and the tubes lanced just before the first test began. The tubes were lanced once about the middle of the 35-lb. test, and every four hours on the 40-lb. test.

"The thickness of the fuel bed on the 15-lb. test was from 4 to 6 in. at the front, and 6 to 10 in. at the rear. As the rate of combustion increased the thickness was somewhat increased. The thickness at start and finish averaged 4 to 5 in. on all the tests. On the forced blast tests the blast was momentarily taken off by partly closing the flue damper while making the first and last observations of the condition of the fire.

Method of Obtaining Data.

"The coal was weighed by the barrow load before being wheeled into the fireroom, where it was mixed. Samples of every few loads were taken for moisture determination, and at the close of the test these were re-sampled and a portion dried on the hot iron flue of the boiler. The moisture was determined from the first six

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hours of drying, after which the samples gained slightly in weight.

"The water was weighed in two cylindrical tanks set on platform scales, which were filled and emptied alternately. They discharged into a third cylindrical tank placed beneath, from which the feed pump took its supply. The water was pumped through a tubular heater and thence to the upper drum of the boiler, which it entered below the water line. For heating the feed water live steam was used, and the supply of steam for this purpose was regulated in accordance with the indications of a registering thermometer chart, the intention being to maintain it constantly at about 200 deg. The two weighing tanks held some 2,700 lb. of water each. One inch depth in the lower tank represented 58 lb. of water, and 1 in. in the upper drum of the boiler at the ordinary water line, 275 lb.

"The quality of the steam was determined from a calorimeter constructed out of 1-in. pipe fittings arranged on the principle of the writer's calorimeter, and attached to the main steam pipe near the boiler. The orifice in the instrument was 3/32 in. in diameter. The normal readings of the lower thermometer, which were ascertained at the close of the trials, corresponding to various readings of the upper thermometer, were as follows, each being obtained by averaging a number of individual readings:

Upper thermometer.	Lower thermometer.
379.5	304.7
380 0	304.9
380.5	305.2

"The force of draft on the 15-lb. test was taken by means of an Ellison multiplying draft gage. The force of blast on the remaining tests was obtained from the same gauge, which was attached to the wall inside the fireroom. When the blast in the room was observed the suction leg was open to the air of the room. When the blast in the flue was observed, the pressure leg was connected to the flue, the suction leg being still connected to the outer air. On the 40-lb. test the damper was wide open and there was a slight suction in the flue instead of pressure. On the remaining tests the damper was more or less closed. At the base of the stack a steam jet was in constant use, maintaining a ¼-in. draft.

"The draft, or blast, was taken not only in the room and flue, but also at the furnace, at the bottom of the first and second passes, and at the top of the last pass. The draft at the bottom of the stack beyond the damper was taken with an ordinary U-tube gage containing water. The average readings thus obtained were as follows:

Rate of combustion, lbs.	15.	25.	35.	40.
Draft in furnace, in...	0.06	....	....	....
Draft in first pass, in..	0.08	....	....	....
Draft in seco d pass, in.	0.15	....	....	....
Draft in third pass, in.	0.23	....	....	0.18
Draft in flue, in.....	0.23	....	....	0 18
Draft in stack, in.....	0.5	0.5	0.5	0 5
Blast in fire room, in..	....	1.11	1.67	1.61
Blast in furnace, in...	....	0.87	1.16	1.06
Blast in first pass, in...	....	0 76	0.94	0.79
Blast in second pass, in.	....	0.56	0.58	0.39
Blast in third pass, in.	....	0.47	0.09	....
Blast in flue, in.....	....	0.47	0.09	....
Difference between blast in fire room and blast or draft in flue, in...	0.23	0.64	1.58	1.79

"The flue temperature was taken from a mercury thermometer inserted in the side of the flue in front of the damper.

"Electric pyrometers were inserted in the flue and in the three passes of the boiler, and the relative temperatures of the gases determined at those points. The uncorrected average readings were as follows:

Rate of combustion, lbs.	15.	25.	35.	40.
First pass pyrometer, deg.	913	1,032	1,103	1,129
Second pass pyrometer, deg.	552	657	693	710
Third pass pyrometer, deg.	488	543	721	728
Flue pyrometer, deg.....	417	484	531	542
Temperature of cold end of flue couple, deg....	172	156	143	137

"The temperatures of the air in the boiler room on the four tests, taken at the side of the room, were found to be respectively 100 deg., 99 deg., 86 deg., and 84 deg. Those in front of the boiler were 115 deg., 103 deg., 87 deg., and 87 deg.

The readings of the various instruments showing pressures, temperatures and draft, and the height of water in the boiler and feed tank, were taken regularly every half hour. Provision was made to have the entering water from the weighing tank shut off and the tank weighed at the same time, so as to determine at the expiration of each half hour the precise amount of water fed.

Personnel.

"The assistants employed by the boiler company embraced one for weighing coal and ashes, two for weighing water and manipulating the supply and discharge valves of the weighing tanks, one for taking the half-hourly readings, one for gas analysis, one for regulating the output of waste steam to maintain a uniform boiler pressure, one for regulating the feed pump and feed temperature, and

TABLE I. DATA AND RESULT OF OFFICIAL TESTS. MOSHER WATER TUBE BOILER, OSSINING, N. Y.

Grate surface, 91.2 sq. ft.	Heating surface, 3.980 sq. ft.			
Nominal rate of combustion, pounds.....	15.	25.	35.	40.
Date of test, 1910	Nov. 1-2.	Nov. 2-3.	Nov. 3-4.	Nov. 4-5.
Weather.....	Cl ar.	Fair.	Rain.	Rain.
Total Quantities:				
1. Duration of test, hrs.....	24	24	24	24
2. Weight of Pocahontas coal as fired, lbs.....	22,167	38,469	58,634	70,603
3. Weight of Somerset coal as fired, lbs.....	11,083	15.381	17,589	16.800
4. Total coal as fired, lbs.....	33,250	53,850	76,223	87,403
5. Percentage of moisture in coal (average), %..	2.4	2.5	3.4	4.4
6. Total weight of dry coal consumed, lbs.....	32.452	52,504	73,631	83,577
7. Total ash and refuse, lbs.	2.747	3,778	4,345	4.949
8. Total combustible consumed, lbs..	29,705	48,726	69,286	78,628
9. Percentage of ash and refuse in dry coal, %..	8.5	7.2	5.9	5.9
10. Total weight of water fed to boiler, lbs.....	339,100	539,403	712,153	818,836
11. Water actually evaporated, corrected for superheat in steam, lbs.	339,303	539,727	712,509	819,250
12. Equivalent water evaporated into dry steam from and at 212°, lbs.....	356,947	569,411	755,972	882,327
Hourly quantities:				
13. Coal consumed per hr. as fired, lbs.....	1,385.4	2,243 7	3,176	3,641 8
14. Coal per sq. ft. of grate as fired, lbs.....	15.2	24.6	34.8	39.9
15. Water evaporated per hr., lbs.....	14,137	22,488	29,688	34,135
16. Water evaporated per hr. from and at 212°, lbs.	14,873	23,725	31,499	36,763
17. Water from and at 212° per sq. ft. of heating surface, lbs.	3.7	6.0	7.9	9.2
Average pressures, temperatures, etc.:				
18. Steam pressure by gage. lbs.....	178.1	179.9	180.2	180.7
19. Temperature of feed water entering boiler, deg.	213	209.8	204.4	189.1
20. Temperature of escaping gases by mercury thermom., deg.	507	568	596	625
21. Force of draft between damper and boiler, in..	0 23	...	...	0.18
22. Force of draft in furnace, in.....	0.06	...	...	...
23. Force of blast in closed fire room, in.....	....	1.11	1.67	1.61
24. Force of blast in flue between damper and boiler, in.	....	0 47	0.09	....
25. Quality of steam (dry steam = unity).....	1.0006	1.0006	1.0005	1.0005
Economic results:				
26. Water evaporated per lb. of dry coal, lbs.....	10.456	10.280	9.677	9.802
27. Equivalent evaporation from and at 212° per lb. of dry coal, lbs	10.999	10.845	10.267	10.557
28. Equivalent evaporation from and at 212° per lb. of combustible, lbs.....	12.016	11.686	10.910	11.222
Efficiency:				
29. Calorific value of dry coal per lb.,* B. T. U....	14,915	14,973	15,040	15 088
30. Calorific value of combustible per lb.,* B. T. U.	15,511	15,526	15,544	15,557
31. Efficiency based on dry coal, %.....	71.5	70.0	66.0	67.6
32. Efficiency based on combustible, %.....	75.1	72.7	67.8	69.7
Gas analysis:				
33. Carbon dioxide (CO_2), %	12.4	11.7	10.6	11.5
34. Oxygen (O), %	6.1	7.05	8.1	7.0
35. Carbon monoxide (CO), %	0.4	0.36	0.4	0.5

*Based on B. T. U.'s obtained from samples of 40-lb. test, viz.: 15,322 coal, 15,619 combustible, Pocahontas; and 14.102 coal, 15,295 combustible, Somerset.

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TABLE 2. HEAT BALANCE, REFERRED TO COMBUSTIBLE.

Nominal rate of combustion, lbs.	15.	40.
1. Heat absorbed by boiler (efficiency), %	75.0	69.7
2. Loss due to moisture in coal and to moisture formed by burning of hydrogen, %	3.9	4.3
3. Loss by heat of escaping gases, %	11.2	15.7
4. Loss by CO in gases, %	1.8	2.5
5. Loss by radiation, carbon and other unconsumed combustibles in gases, and unaccounted for, %	8.1	7.8
Total %	100.0	100.0

Note:—The proportion borne by the carbon in the coal to the combustible is assumed to be 0.9, and that of the hydrogen to the combustible, 0.05.

one for directing the firemen. There were two shifts of these assistants, each being on duty 12 hours and off 12 hours. The assistants representing the navy consisted of one for coal, one for water and one for half-hourly readings, working in shifts of eight hours each. The data was taken simultaneously by the two parties and checked.

"The writer, who had general charge of the whole work, was present throughout the tests, excepting a few hours during the latter part of each night.

"The method adopted for determining the normal readings of the calorimeter was in accord with the naval board's directions.

Gas Analyses.

"A sample of the escaping gases was drawn out of the flue by means of an aspirator, which was in constant operation. The pipe carrying the gas was connected to a pair of large bottles in which continuous samples were collected in the usual manner, the drawings lasting about 15 minutes each, and following one another as quickly as possibe. One analysis was made of each bottleful of gas, using the familiar form of Orsat apparatus. There was no break in the drawings on account of firing conditions, the intention being to obtain the average composition of the gases throughout the trial. The filling of the bottles occupied about three-fourths of the time of the entire run.

"The hourly composition of the gases as regards the percentage of carbon dioxide (CO) ranged as follows:

15 lb. test, 0 to 1.4%
25 lb. test, 0 to 1.1%
35 lb. test, 0 to 1.4%
40 lb. test, 0 to 1.6%

"The percentage of CO for single bottles of gas was sometimes greater than the average for the hour, on one occasion reaching 4 per cent.

"The 17 1-in. holes in each of the five doors were wide open during the first two tests and during the first eight hours of the third test. During the remaining 16 hours of the 35-lb. test, and during the entire run on the 40-lb. test, 11 of these were closed, leaving five open. The average percentage of CO in the gases during the second eight hours of the 35-lb. test was the same as the average during the first eight hours, but the average percentage of oxygen was 1 per cent less during the second eight hours than during the first. The clinkers were removed twice during the second period, as against once during the first period. The accumulation of clinkers was always accompanied by an increase of CO, and their removal by a reduction of CO. For example, between the hours of 11 a. m. and 12 m. on the 35-lb. test the average CO was 1.4 per cent. Between 12:22 and 1:11 p. m. the fire was sliced and barred up, and the large clinkers removed. The CO fell to 0.8 per cent from 12 m. to 1 p. m., to 0.3 per cent from 1 to 2, and 0.2 per cent from 2 to 3.

Data and Results.

The leading data and results of the tests appear in the appended Table 1, followed by heat balances worked out for the 15-lb. and 40-lb. tests given in Table 2, and memoranda regarding some of the important dimensions of the boiler given in Table 3. A blueprint showing a side elevation and cross-section through the furnace is also appended.

"The calorific values of the coal given in Table 1 are based on the writer's determination from samples obtained on the 40-lb. test, using his oxygen calorimeter, the assumption being made that the coal was all of substantially the same quality.

"It will be seen that the evaporative results, which are given in line 31 of Table 1, are respectively 12.016 lb., 11.686 lb., 10.91 lb., and 11.222 lb.

Comments on the General Results.

"Considering the results as a whole, the performance of the boiler, in view of the unfavorable character of the fuel, is most satisfactory.

"The comparatively low efficiency obtained on the 35-lb. test appears to be accidental rather than representative of the true performance under favorable conditions. I have been unable to ferret out of the data a wholly satisfactory explanation of this result, but the reason may possibly be traced to short-circuiting of the gases in their passage through the last pass, due very likely to the partially closed position of the damper on this test. A comparison of the draft and blast pressures in the various passes, as well as the temperatures revealed by the electric pyrometers, furnishes strong evidence pointing in that direction. One of the most noticeable

TABLE 3. MEMORANDA REGARDING TEST BOILER.

1. Total number of tubes	883
2. Outside diameter of tubes	2 in.
3. Average length of tubes	8 ft. 5.6 in.
4. Number of rows high	19
5. Number of tubes wide in 10 rows	46
6. Number of tubes wide in 9 rows	47
7. Horizontal pitch of tubes	3.5 in.
8. Area of heating surface below center of drum	3,912 sq. ft.
9. Area of heating surface above center of drum*	68 sq. ft.
10. Total heating surface	3,980 sq. ft.
11. Length of grate	7.02 ft.
12. Width of grate	13.0 ft.
13. Width of air spaces and bars in grate	0.5 in.
14. Pitch of grate	9.0 in.
15. Area of grate surface	91.2 sq. ft.
16. Distance from front end of grate to nearest tube	4 ft.
17. Distance from rear end of grate to nearest tube	1 ft. 11 in.
18. Distance from upper drum to lower drum measured along center line	8 ft
19. Distance from upper drum to first flame plate	3 ft. 1 in.
20. Distance from first flame plate to second flame plate	2 ft. 7.5 in.
21. Distance from second flame plate to lower drum	2 ft. 2 in.
22. Distance from top of first flame plate to top of tube space	1 ft. 10 in.
23. Distance from bottom of second flame plate to lower brick baffle	1 ft. 6 in.
24. Area of opening through first pass	17.2 sq. ft.
25. Area of opening above first flame plate	24.6 sq. ft.
26. Area of opening through second pass	14.4 sq. ft.
27. Area of opening below second flame plate	14 sq. ft.
28. Area of opening through third pass	12.1 sq. ft.
29. Area of opening below smoke outlet	19.1 sq. ft.
30. Area of heating surface in furnace (two lower rows)	445 sq. ft.
31. Area of heating surface in first pass	1,405 sq. ft.
32. Area of heating surface in second pass	1,074 sq. ft.
33. Area of heating surface in third pass	1,056 sq. ft.

*This is the steam heating surface, assuming the water line is at the center line of the drum, which is the normal working point. When the boiler is in very active operation the water is probably at a lower level on the tube side of the drum than on the front where the water glass is attached, and no doubt the steam heating surface is greater under the working conditions than these figures appear to indicate.

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things about the matter is that the apparent temperature on the 35-lb. test, according to the electric pyrometers, was 28 deg. higher in the third pass than in the second pass, whereas, on the 25-lb. test it was 114 deg. lower. Of course, these can represent only the local temperatures at the points where the electric couples happen to be placed—not the average temperature of the entire body of gas in the two passes—and short circuits readily account for these apparent inconsistencies.

"I am of the opinion that a coal of equal calorific value and having the same volatile characteristics, but free from the troublesome slag constituent, would have given higher efficiencies throughout the series."

Heavy Oil Engines for Marine Purposes

By G. C. Davison.*

SINCE the time of Robert Fulton, a period covering a century, the steam engine has been and is still generally considered the one practicable means, sails excepted, for the propulsion of ocean-going vessels. During this extensive period, the reciprocating engine has been developed to a point beyond which no appreciable progress can be made. The steam turbine has been developed, but only under certain circumstances can it exceed in economy the reciprocating engine. Water-tube boilers have been developed and have also reached a practicable limit of efficiency. As a final step, oil has been introduced as fuel with water-tube boilers, so that today the most advanced steam motive power consists of water-tube boilers, fired with liquid fuel, and turbine engines, together with a complicated mass of auxiliaries, such as feed pumps, blowers, air pumps, circulating pumps, etc. Such installations are expensive from all points of view, first cost, attendance, fuel and repairs, so that practically we find them only on naval vessels where the utmost power on the least weight is demanded regardless of cost. Omitting the oil fuel feature, and substituting coal, we find a few trans-Atlantic steamers, heavily subsidized, using the same modern steam system. But the remaining 99 and a fraction per cent of the world's merchant marine is propelled by an installation consisting of coal burning boilers and reciprocating engines.

So much for what actually has been and is. As for what has been proposed, there may be mentioned the gasoline engine, which is prohibitive, due to the cost of gasoline; the use of light, high-speed turbines with electrical or gear transmissions, thus far but little more than paper propositions, from which a certain amount of economy may be reasonably expected, but which saving, when compared with that of the heavy oil engine, sinks into insignificance. The gas turbine, which has occupied the attention of able engineers and inventors for years, but for which practicable results are still lacking. The producer gas plant which has been given serious attention, but which up to date can use only anthracite coal, and for marine purposes has been installed as an experiment on only a few small vessels.

*Late Lieutenant Commander, United States navy.

Use of Heavy Oil Engines.

Of all the proposed systems involving internal combustion engines for marine purposes, the heavy oil engine, using high compression, has been the one which for years engineers have predicted success. These predictions have at last been realized, so that, at the present time, many thousands of horsepower derived from heavy oil engines are used for the propulsion of vessels. All of the submarine boats of the world, which have been built in the past few years, have been equipped with these engines, each boat having from 600 to 1,000 H. P. In addition, fishing vessels, tank steamers and tugs in Europe have been equipped with these engines, and have been run long enough to fully demonstrate their practicability and economy. By far the greatest part of this development work has been done in Germany, the firm of Augsburg-Nurnberg having taken a leading part. In the United States, little progress has been made as regards heavy oil engines for marine purposes. The Diesel engine has been used with considerable success for stationary work. But for marine purposes, the only installation of heavy oil engines known are those in the submarine boats being built by the government. It is understood that a new concern, The New London Ship & Engine Co., has acquired the exclusive United States rights to the Nuremburg engine, and is preparing to build them for commercial purposes at its new plant in New London, Conn.

The Nuremburg Type of Engine.

A mere enumeration of the advantages of the heavy oil engine of the high-compression type, as represented by the Nuremburg engine, would fail to give an understanding of the possibilities of this motor, and of the far reaching effect which it is bound to have upon the problem of transportation. Some time ago, Prof. Koklunsky, of Russia, after carefully investigating the subject, stated that "owing to dispensing with firemen, reduced fuel consumption and increased cargo capacity and passenger accommodation, as compared with a steam vessel of the same size, the annual gross earnings would be increased by 25 per cent, which would mean an increase of 8 per cent on the capital involved".

But, fortunately, at the present time, we have some definite data in regard to the Hamburg-American ships now building, and from this information we can obtain a fairly approximate idea of the earning capacity which will be realized.

The first of these vessels is of 7,000 tons displacement, is provided with two Nuremburg engines of the double-acting two-cycle type. Each engine developing 1,000 horsepower, has three working cylinders of 18.9 in. diameter, 25.6 in. stroke, and makes 120 revolutions per minute.

The weight of the engines is about 88 lb. per horsepower. To this must be added weight of shafting and propellers, which will make the weight per horsepower about 100 lb. On a steamer of the same size and power, the weight of boilers, engines, shafting, piping and auxiliaries, will amount to 300 lb. per horsepower.

As regards fuel consumption, the Nuremburg engines are guaranteed to use less than one-half pound per horsepower hour. A steam vessel of the same class, when new might, on trial, use less than 2 lb. of coal per horsepower hour. But in practice, it is thought that an average consumption of 2 lb. per horsepower hour

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would be considered a very satisfactory performance.

Comparisons of Cost.

The only other data now needed to make a comparison is the price of fuel. Coal ranges in price from $3 a ton to $30 a ton in various parts of the world. For a cargo steamer making distant voyages an average price of $5 per ton will be used in making the comparison. Fuel oil ranges from 2 cents to 3 cents per gallon along the entire coast line of the United States, and for a foreign voyage can, if necessary, be carried in sufficient quantity for the round trip. The average density of fuel oil is such that the weight per gallon is approximately 7.4 lb.

Finally, the cost of attendance must be considered. The force employed on steam vessels is well known, and depends largely upon the nature of the service on which the ship is engaged. In a heavy oil installation, the fire room force is entirely eliminated, while no increase is required in the engine room. Two men on watch at a time would be ample with the heavy oil engines above described.

From the foregoing, it is a simple matter for a steamship owner or manager to calculate what savings would be effected, supposing heavy oil to be substituted for steam on the vessels he is now running, taking the same freight and passenger rates as now exist.

As a matter of interest the following table has been prepared, making a comparison of the 7,000-ton Hamburg-American ship with a steam ship of the same displacement and power. In this comparison, the cost of attendance is based on American scale of wages. The freight rate is assumed as an average of $5 a ton for a voyage of 5,000 miles. These items would, of course, vary with nationality, character of cargo and route:

7,000 ton cargo ship, 2,000 H. P.:	Steam.	Heavy oil.
Weight of machinery, lbs. per H. P.	300	100
Total weight of machinery, tons	268	90
Weight of fuel per H. P. hr., lbs	2	0.5
Weight of fuel per hr., lbs	4,000	1,000
Weight of fuel per day, tons	42.7	10.74
Weight of fuel for voyage of 5,000 miles (tons)	790	197.5
Weight of fuel for round trip, tons	1,580	395
Cost of fuel	$5 ton	3c gallon
Cost of fuel for round trip	$7,900	$2,840
Cost of attendance for round trip	$1,000	$500
Cost of lubricating oil, waste, etc	$430	$430

From the foregoing table, the following is found in favor of the oil engine ship:

	Tons.
Saving in weight of machinery	178
Saving in weight of fuel	1,185
Total weight saved, available for cargo.	1,363

The cargo capacity of such a vessel fitted with steam engines would probably be about 4,000. Therefore, the increase in cargo capacity, and consequently in gross earning capacity would be

$$\frac{1363}{4000} = 34 \text{ per cent,}$$

or 9 per cent more than the estimate of the Russian professor above quoted.

This figure does not, however, represent the total saving, which for a voyage, may be summarized as follows:

1,363 tons cargo	$13,630.00
Saving in fuel	5,060.00
Saving in wages, engineer's force..	500.00
Total saving for voyage	$19,190.00

To this would also be added cost of fresh water for make-up feed, or cost of fuel for distilling same.

Such a vessel could make at least five voyages per year. Therefore, total yearly saving would be $95,950. The capital invested in such a ship would be somewhere in the neighborhood of $450,000. Therefore, the saving due to use of oil engines would be 21 per cent on the capital invested.

Therefore, a ship now using steam and earning 6 per cent dividends, could, by using heavy oil engines, all other conditions remaining the same, earn 27 per cent dividends.

New Oil Engine Liner

Speaking at a complimentary dinner in Glasgow on Feb. 6 to James Gilchrist, chairman of Messrs. Barclay Curle & Co., shipbuilders, Glasgow, William Russell Ferguson, a director of the company, referred to the large oil-engined vessel which the firm is at present building. Mr. Gilchrist, he said, was celebrating the jubilee of his association with the company by being actively engaged in the construction of a set of large internal-combustion oil engines, a type of engine which combined with the discovery and development of new oil-fields and the corresponding increase in the oil-producing capacity of the world, bade fair to become a serious competition to steam propulsion and to supersede to some extent, at least, steam engines and boilers.

The vessel which they were building had been referred to as of 7,000 tons. As a matter of fact, she was of 5,000 gross, and 7,000 tons dead-weight. She would have twin screws, and was designed for 12 knots speed. The propelling machinery would consist of two sets of combustion cylinder engines of the Diesel type, with improvements which had overcome the initial difficulties in connection with starting and reversing the engines, and in connection with other minor points. There would be on board another, but smaller, engine of the same type, which would generate electric power to drive the winches, the windlass and the steering gear, and also to provide current for lighting the vessel.

The advantages of the new engine were that it could be worked with the cheapest kind of oil—the kind which could be bought at present from $8.50 to $10 per ton, and that there was no magnetic spark required to ignite the charge, which was done by compression. The engines could be started in five minutes, as compared with the 15 hours required to raise steam in boilers. There would be no boilers, no funnels, and no coal bunkers. The oil would be carried in specially constructed tanks. They estimated that 100 tons would take the vessel as far as 300 tons of coal, and the space necessary for fuel would be only about one-fourth of that required for bunker coal. There would be no firemen and no smoke, ashes and dirt. The boat Mr. Ferguson added, would carry some passengers, and she was not intended for British owners. It was very probable that within the next two years they would see large vessels sailing the Atlantic without funnels or boilers, and that those vessels would be popular with passengers because of the absence of smoke, soot and dirt.

Gas-Driven Cargo Vessel

J. T. Eltringham & Co., South Shields, launched on Feb. 16 the first sea-going, gas-driven cargo vessel to be constructed in Great Britain. The vessel was christened Holzapfel I and is being built for the Holzapfel Marine Power Syndicate of London. She is 120 ft. long between perpendiculars, 22 ft. beam and is intended to carry a little over 300 tons deadweight on a draught of 10 ft.

A set of high-speed six-cylinder vertical gas engines will be placed aft. They will have double ignition, and give 180 brake horsepower at 450 revolutions per minute. The gas plant is in duplicate, each division being of 100 H. P. The producers are square in section and will stand side by side on the port side of the vessel, with their

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faces to the engine room. The scrubbers will stand forward of the producers, and are about 13 ft. high, the upper portion being the wet cooler and the lower portion the dry scrubber. Both producers and scrubbers are enclosed in a gas-tight compartment separated from the engine room, and furnished with two 12-in. ventilators.

The power of the gas engine will be transmitted to the propeller shaft by means of a "Fottinger" transformer, which, as an intermediary between the gas engine and the propeller shaft, reduces the revolutions of the latter to any desired number, within certain limits, while the gas engine is working at full speed. It can also stop or reverse while the gas engine is running at full speed ahead. Its action is practically instantaneous. The loss of power entailed by its use varies from 3 per cent to 20 per cent, according to size, and to the gear or ratios of the number of revolutions of the prime mover to the number of those of the propeller shaft. A favorable ratio is from 300 revolutions of the prime mover to about 100 revolutions of the propeller shaft, and this, in general practice, permits a high-speed gas engine of light weight and low first cost to be used with a propeller of high efficiency. The "Fottinger" transformer is, in effect, a hydraulic clutch, and consists of a centrifugal pump delivering water into a turbine. There are two turbines, one driving ahead, the other astern. The water is conveyed to them through a reversing valve actuated by a hand lever, and when this lever is in its middle position the gas engine continues to revolve without driving the propeller. The engine always runs in the same direction whether the propeller is going ahead or astern. In Holzapfel I. the transformer is geared from 450 revolutions of the gas engine to 120 revolutions per minute of the propeller. The transformer, together with the thrust block, is coupled direct to the engine, and the two occupy a total length of about 20 ft.

The vessel has a donkey boiler, 5 ft. diameter and 8 ft. 6 in. high, and two steam winches, each of 2 tons capacity. The donkey boiler and its coal bunker are placed on the starboard side, and they together about counterbalance the weight of the gas plant. The bunker supplying the gas producer is in the poop, and will contain about 12 tons. It will feed into the hoppers of the two producers, and very little trimming will be required. It is expected that the consumption of anthracite coal will be from 25 cwt. to 30 cwt. daily, as against 3½ tons of steam coal for compound engines of equal power, such as are generally used for vessels of this size. An air compressor and air cylinders will be fitted for starting the gas engines. When the vessel is about to get under way, the engines will be set going and the lever regulating the transformer will stand at "stop." During the slow speeds and stoppages the engines will remain in motion, the transformer giving the power to the propeller shaft only when required. The blowing on of the gas producers while they are being lighted up will be effected by an arrangement of air injectors supplied from the compressed air cylinders.

Holzapfel I. being only a small vessel and intended for short voyages—chiefly for carrying coals from South Wales ports—will not be fitted with an evaporator for supplying fresh water to the vaporizers of the producers, but the fresh water necessary for this purpose will be carried in the after peak tank, and the steam winches will exhaust into this tank to augment the supply. The hull, engines, and gas plant will have the highest class at Lloyds Register, and 7½ knots will represent the vessel's average speed.

Rules for Construction of Lake Vessels

THE Record of American and Foreign Shipping for 1911, the vessel register conducted by the American Bureau of Shipping of New York, is now being distributed to subscribers. The Record contains besides the vessel register complete rules and tables for the construction, inspection and classification, of all types of vessels of steel or wood construction for ocean, lake and river, freight and passenger service, tug boats, yachts, etc.

The 1911 edition has been entirely reprinted and all construction rules revised and rearranged. A feature of particular interest to vessel owners and builders on the lakes is an entirely new section devoted exclusively to freight vessels of the modern types in use on the great lakes. The construction rules and tables in this section are complete in themselves and include many new features to facilitate the work of taking out the scantlings for any required vessel. Standard frame facings of 24 in. and 36 in. are considered and the tables for sheer strakes, stringers and other important parts of the structure, cover a range of proportions wide enough to cover all requirements which may reasonably be anticipated for some years to come. The latest types of construction with arched plate deck beams, with side web frames in place of hold beams stanchions, and with or without side ballast tanks are also fully covered in the rules and illustrated in tables showing typical arrangements for vessels of varying dimensions.

The 1911 edition does not contain the section included heretofore covering the construction of vessels for lake, bay and river service as this was still under revision when going to press, but these rules, when completed, may be obtained in pamphlet form upon application.

A large number of the latest types of lake vessels built in the past few years have been built under the supervision of and classed by the American Bureau of Shipping, represented on the great lakes by Alex Hynd, 872-4 Rockefeller building, Cleveland.

Though the present issue of the rules does not include the Isherwood system of longitudinal framing construction a number of vessels lately built in Atlantic coast ship yards on this system have been built under the supervision of and classed in the Record.

Two large colliers lately built by the Maryland Steel Co. for the United States navy were built without government supervision, but under the stipulation in the contract for their acceptance that they should be built under the supervision of the American Bureau of Shipping and receive the highest classification in the Record.

The American Bureau of Shipping lately took over the business and publication of the United States Standard Register and vessels originally classed in that register will be continued in class in the Record subject to periodical surveys under the rules of the original classification.

The American Bureau of Shipping thus remains the only exclusively American classification register doing

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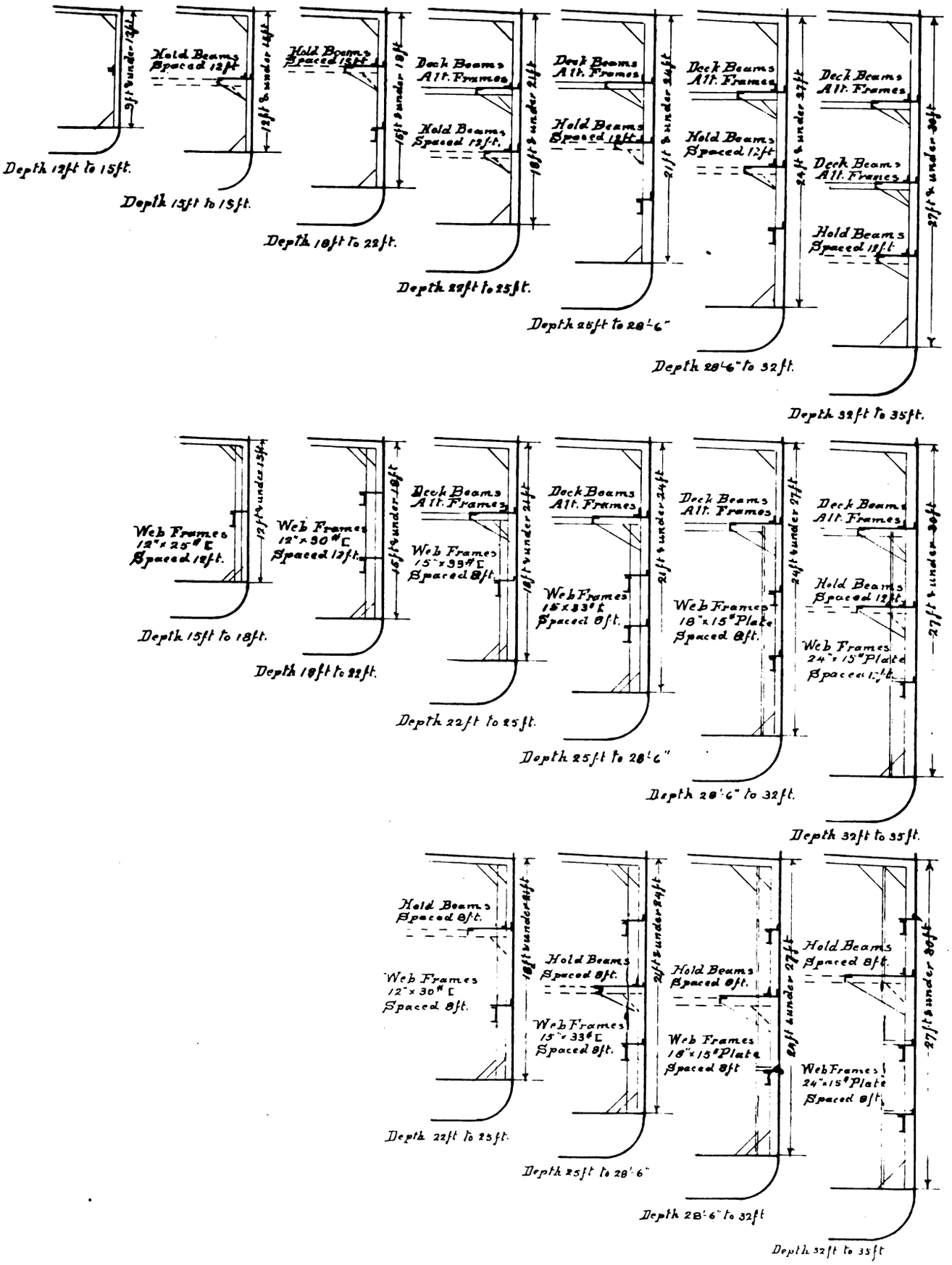
Hold Beams Spaced 12ft
Deck Beams Alt. Frames
Hold Beams Spaced 8ft.
Web Frames 12"x25# C Spaced 12ft.
Web Frames 12"x30# C Spaced 12ft.
Web Frames 15"x33# C Spaced 8ft.
Web Frames 18"x15" Plate Spaced 8ft
Web Frames 24"x15" Plate Spaced 8ft
Depth 12ft to 15ft.
Depth 13ft to 15ft.
Depth 15ft to 18ft.
Depth 18ft to 22ft.
Depth 22ft to 25ft.
Depth 25ft to 28'-6"
Depth 28'-6" to 32ft.
Depth 32ft to 35ft.

TABLE 6, PART 1. ARRANGEMENT OF HOLD STRINGERS, HOLD BEAMS AND WEB FRAMES. SPACING OF FRAMES, 24 INCHES.

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business on the sea-board of the United States and the greater number of all vessels built in the coast ship yards are constructed under its rules and under the supervision of its surveyors.

Classification.

Vessels built in conformity with, or equal to, the rules and under the inspection of the authorized surveyors of the bureau will, if used exclusively for service on fresh waters of the great lakes and tributaries, be entitled to class A1 for 25 years.

Vessels built in conformity with or equal to these rules, but not under inspection, may be classed under Special Survey and will be given term according to the material used and the mode of building.

Section IV.—Dimensions and Numerals for Scantling.

LENGTH.—For steamers, the length to be taken from the forward side of stem to after side of the stern post at load-water line.

BREADTH.—To be molded breadth of the midship, or "dead flat" frame.

DEPTH.—To be molded depth of the vessel measured at the lowest point from the upper side of one and two-deck vessels, and of three-deck vessels when the upper deck is not a hurricane deck. Hurricane deck vessels to have the depth taken to the top of the deck beam of the deck next below the hurricane deck.

NUMERALS.—The numerals for regulating scantlings are obtained as follows:

The first numeral is the sum of the breadth and twice the depth. Second numeral is the first numeral multiplied by the length in feet. In construction of steel tow barges, the second numeral, as used for determining the scantlings of shell plating, keelson plates, stringers and stringer angles, etc., may be reduced 25 per cent, and scantlings taken as corresponding to reduced numeral, except in cases of bar keels, stems, stern posts, rudder posts and rudders, which will be as given in accordance with the true numeral.

Vessels With Full Poops and Topgallant Forecastles.

For vessels with full poops and topgallant forecastles and enclosed bridge houses, the depth for obtaining the numerals regulating the scantlings, also for determining the proportion of depth to length, to be the depth to upper deck. The second numeral for scantling is to regulate the requirements as to anchors, chains, hawsers and warps, except the length of one, or combined lengths of more than one, of above structures exceeds half the vessel length, in which case 10 per cent added to second numeral for scantlings will be the numeral for regulating the requirements as to anchor, chain, hawser and warps.

Vessels With Raised Quarter Decks and Raised Fore Decks.

The depth for calculating the numerals for scantling and for anchors, chains, hawsers and warps to be measured to upper deck.

Section V.—Keels.

BAR KEELS.—Bar keels to be made of hammered scrap iron or rolled bar iron of extra quality or of approved steel. The different pieces to be welded or scarphed to each other and to stem and stern post; if scarphed, the lengths of scarphs to be not less than ten times the thickness of the keel, and they are to be planned, fitted to a face joint and caulked; the necessary rivet holes in the thin ends of the scarphs are to be drilled after the scarphs are fitted.

Flat plate keels to be not less than the width and thickness specified in Table No. 2, part 2. The plates at the forward and after ends are to overlap on the bottom extensions of the stem and stern post a distance not less than equal to three frame spaces, and to be riveted through and through the extensions of the stem and stern post and the bottom angles of the center keelson.

Vessels with a flat keel to be fitted with a continuous middle line keelson of scantling and construction specified in Section X and Table No. 3, connected its full length to the flat plate keel by double angle bars of scantling specified for keelson angle bars.

Section VI.—Stem and Stern Posts.

STEM.—To be of best hammered scrap iron of prescribed scantling for stems and bar keels. The reduction at the upper end to be gradual, commencing at the load-water line.

IN CONNECTION WITH BAR KEEL.—When connected to bar keel, the weld or scarph to be as described in connection with bar keel.

IN CONNECTION WITH FLAT PLATE KEEL.—When fitted in connection with a flat plate keel, the lower part to be tapered down in height and increased in width to that of the flanges of the bottom angle of the center vertical keelson, and to extend aft to such length as to admit of a proper connection to the bottom angles of the center vertical keelson, over a length of not less than three frame spaces.

STERN FRAME.—Stern posts to be of best hammered scrap iron of prescribed dimensions according to type used.

FOR SINGLE-SCREW STEAMERS.—Stern posts for single screw vessels for use with balanced rudder, to be forged in one piece, with boss for stern pipe, forward extension for connection to center keelson and after extension or shoe for support of the rudder pintle. The upper end to be properly connected to the transom frame between double angles, double riveted. The forward and after extensions at the foot to be formed to the stern post with a radius not less than twice the width of the post. The forward extension to be reduced in height and increased in width with a gradual taper; the width at the forward end to be not less than the combined widths of the flanges of the bottom angles of the center keelson, and to extend forward not less than 6 ft. in small vessels and 10 ft. in larger vessels from the after side of the post, or to a sufficient length to admit of satisfactory connection to the bottom angles of the center vertical keelson over a length of not less than three frame spaces. The after extension or shoe to be of dimensions as given in Table No. 2, part 3, midway of its length, having the greatest dimensions horizontally, and to contain proper bearings for the rudder pintle.

STERN TUBE BOSS.—The boss on the stern post for the stern tube to be in length not less than two-thirds of the outer diameter of the stern tube, and thickness on each side not less than 65 per cent of that of the stern post.

REDUCTION ABOVE BOSS.—The section of the stern post may be reduced above the boss, such reduction not to exceed 25 per cent of the tabular section.

FULL STERN FRAME.—The stern frame of single-screw vessels when not fitted with balance rudder, to be forged in one piece, including stern post with boss for stern tube, and rudder post with pintle, and gudgeon bearings for rudder. The section for the rudder post to be not less than 75 per cent of the section of the stern post. The part between the posts may be of less depth than the keel, but the sectional area at any point must not be less than 33 per cent in excess of that specified for the propeller post. The portion of the stern post projecting into the body of the vessel to be fitted as set forth in paragraph 5.

STERN FRAME FOR TWIN-SCREW VESSELS.—In twin-screw vessels or tow

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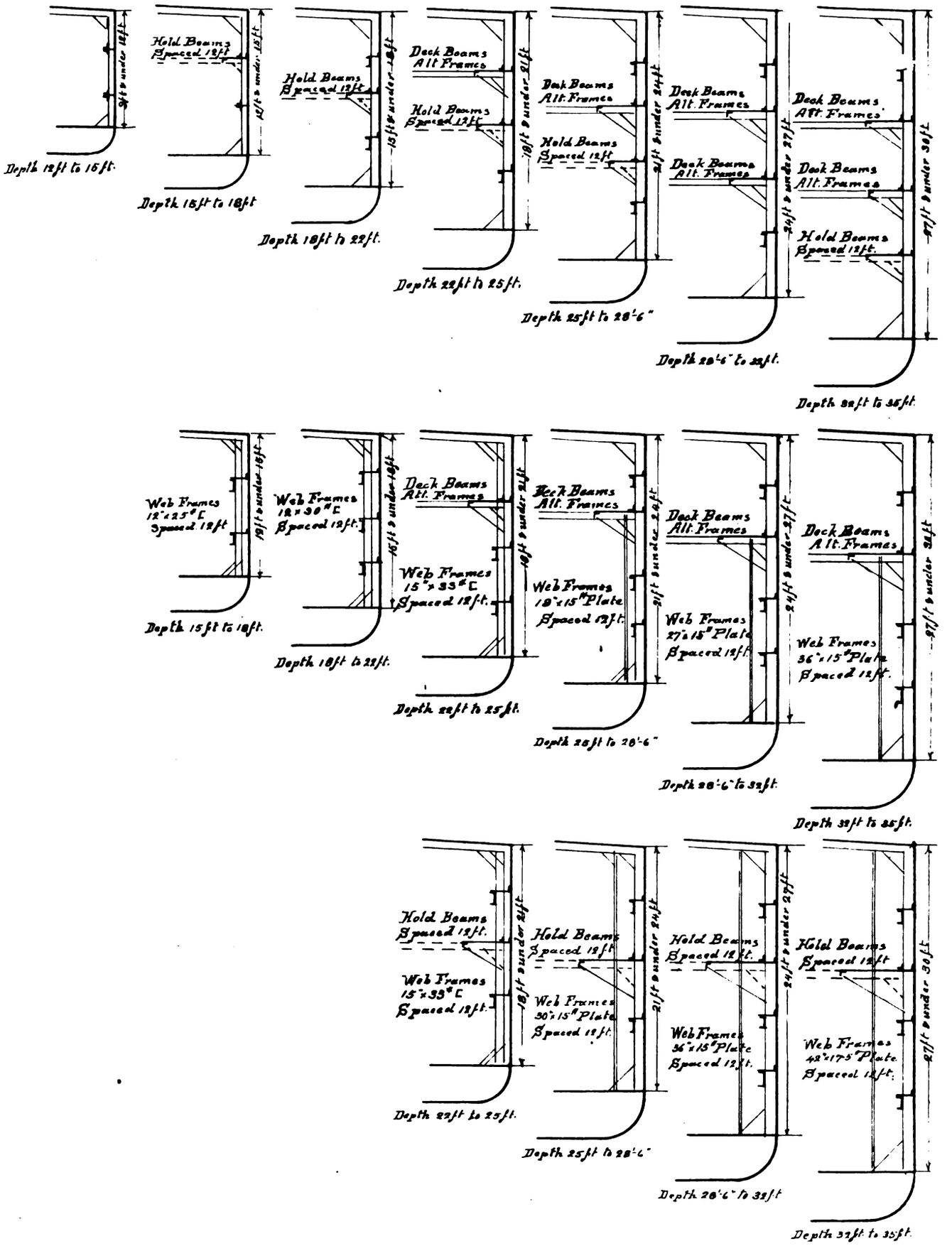
Depth 12ft to 15ft.
Hold. Beams Spaced 12ft
Depth 15ft to 18ft
Hold Beams Spaced 12ft
Depth 18ft to 22ft.
Deck Beams Alt Frames
Hold Beams Spaced 12ft
Depth 22ft to 25ft.
Deck Beams Alt. Frames
Hold Beams Spaced 12ft
Depth 25ft to 28'-6"
Deck Beams Alt. Frames
Deck Beams Alt. Frames
Depth 28'-6" to 32ft.
Deck Beams Alt. Frames
Deck Beams Alt. Frames
Hold Beams Spaced 12ft.
Depth 32ft to 35ft.
Web Frames 12"x25# C Spaced 12ft
Depth 15ft to 18ft.
Web Frames 12"x30# C Spaced 12ft.
Depth 18ft to 22ft.
Deck Beams Alt. Frames
Web Frames 15"x33# C Spaced 12ft.
Depth 22ft to 25ft.
Deck Beams Alt. Frames
Web Frames 18"x15# Plate Spaced 12ft.
Depth 25ft to 28'-6"
Deck Beams Alt. Frames
Web Frames 27"x15# Plate Spaced 12ft.
Depth 28'-6" to 32ft.
Deck Beams Alt. Frames
Web Frames 36"x15# Plate Spaced 12ft.
Depth 32ft to 35ft.
Hold Beams Spaced 12ft.
Web Frames 15"x33# C Spaced 12ft.
Depth 22ft to 25ft.
Hold Beams Spaced 12ft
Web Frames 30"x15# Plate Spaced 12ft.
Depth 25ft to 28'-6"
Hold Beams Spaced 12ft.
Web Frames 36"x15# Plate Spaced 12ft.
Depth 28'-6" to 32ft
Hold Beams Spaced 12ft
Web Frames 42"x17.5# Plate Spaced 12ft.
Depth 32ft to 35ft.

TABLE 6, PART 2. ARRANGEMENT OF HOLD STRINGERS, HOLD BEAMS AND WEB FRAMES. SPACING OF FRAMES 36 INCHES.

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barges fitted with rudder of unbalanced type, the stern post to be of prescribed scantling and to have gudgeon and pintle bearings forged on.

Section VII.—Frames.

SCANTLING OF FRAMES.—The frames to be of prescribed scantling for the type and spacing of frames adopted, and to extend in way of double bottom, they are to extend from keel to upper deck. Where not in the way of the double bottom, they are to extend from keel to upper deck. In vessels having a raised quarter deck or poop deck, raised fore deck or topgallant forecastles, all frames in way of same are to extend to the under side of the stringer plates of the respective decks.

FRAME SPACING.—When frame spacing in general of 36 in. is adopted, the spacing for one-fifth of the vessel's length at the forward end must be reduced to 24 in. and intermediate frames fitted forward of collision bulkhead as per paragraph 7. The spacing at the after end and through the machinery space also to be reduced to 24 in. and frames to be of full midship scantling and additional stiffness provided by means of web frames and extra side stringers, or otherwise, as herewith set forth.

CONNECTION OF FRAMES TO FLOORS.—In way of the double bottom and where ballast tanks are continued up the sides of the vessel, the frames shall be connected to floors by futtock plates or bilge brackets, as prescribed in Section X, paragraph 2. The frames to lap onto the bilge brackets not less than twice the depth of the frame. The riveting of same to be as described in Section XXVII, paragraph 7.

FRAMES CUT AT TANK TOP.—In way of the double bottom, where margin plates extend to the side of the vessel, the frames and floors must be properly connected together by bracket plates of thickness equal to side keelson plates, above and below the margin plate, and connected through the margin plate, by double angles above and below of scantling equal to tabular reverse bars.

FRAMES PASSING THROUGH STRINGERS.—In vessels with side ballast tanks fitted up to the second deck stringer plate, or, if cut at the stringer plate, must be efficiently connected together above and below the stringer plate with plate brackets, as provided for connection at margin plates.

THICKNESS OF CONNECTING BRACKETS.—Brackets at margin plate or at second deck stringer-plate shall be of thickness equal to side keelson plate, and of depth on both sides not less than three and one-half times the depth of the frame.

INTERMEDIATE FRAMES FORWARD.—In the fore peak of all vessels the spacing of the frames must be reduced to not to exceed 18 in. in a fore and aft direction, either by drawing the frames closer together or by fitting intermediate frames between the regular frames. Such intermediate frames to be equal in scantling to the main frames, as for the ends of the vessel, and to extend in two-deck vessels at least up to the second deck stringer plate and to the main in single-deck vessels.

Section X.—Center and Side Keelsons in the Way of Double Bottom.

CONTINUOUS CENTER VERTICAL KEELSON.—All double bottom vessels to have a continuous vertical center-line keelson of dimensions as given in Table No. 3, extending as far forward and aft as practicable, fitted in connection with a flat plate keel. The keelson shall have continuous double-keelson angle bars riveted back to back on the top edge and to the center-line plate of the tank top, and shall also have continuous double-keelson angles throughout at bottom at least three-fourths the vessel's length amidship; and in vessels with water ballast compartments extending up the sides to the main deck stringer plate, the center keelson shall be watertight throughout the entire length of the side tanks.

CONNECTIONS TO STEM AND STERN POST.—The center vertical keelson to extend well into the ends of the vessel and be connected to the bottom extensions of the stem and stern post by means of the bottom keelson angles over a length not less than three frame spaces.

SIDE KEELSONS ON TOP OF FLOORS IN DOUBLE BOTTOM.—Side girder keelsons on top of the floors to be of prescribed thickness and the full height from the top of the floors to the tank top, connected to the tank top with angle bars of reverse bar scantling and having a continuous angle bar fitted at the lower edge on top of the floors, riveted to the keelson plate and to the reverse bars or flanges on top of the floors. Side keelsons shall also have vertical angle bars of length equal to the full depth of the keelson and floors, and riveted to the same on the reverse side from that on which the bottom angle is fitted.

NUMBER OF SIDE KEELSONS.—Vessels whose breadth is 30 ft. and under 40 ft. there shall be three; when the breadth is 40 ft. and under 50 ft., there shall be four; and when the breadth is 50 ft. and under 65 ft., there shall be five side keelsons on each side of the center keelson.

In vessels fitted with deep-plate floors 12 ft. apart, as per Section V, paragraph 15, the number of side keelsons required may be reduced by one in the several cases mentioned in paragraph 4.

SIDE KEELSONS AT ENDS.—The side keelsons should be drawn together towards the ends to a spacing not to exceed 48 in. apart, and continued forward and aft as far as practicable.

INTERCOSTAL PLATES ON SIDE KEELSONS.—In vessels whose breadth is over 30 ft. and under 40 ft., at least one of the side keelsons shall have intercostal plates fitted under the same. In vessels over 40 ft. breadth and under 50 ft., and whose frame spacing is 24 in. at least two of the side keelsons, and with frame spacing 36 in. all of the side keelsons shall have intercostal plates. In vessels over 50 ft. breadth and under 65 ft. whose frame spacing is 24 in., at least three of the side keelsons, and with frame spacing 36 in., all of the side keelsons, shall have intercostal plates. These intercostal plates to lap on the lower edge, and to be riveted to the keelsons and bottom plating and be connected to the floors by angle clips.

CONTINUOUS THROUGH WATERTIGHT BULKHEADS.—Center and side keelsons to be fitted continuous through all watertight bulkheads and made watertight with proper angle collars.

BUTTS OF KEELSON PLATES.—Butts of all keelson plates may be lapped or connected by butt straps properly riveted as per Table 6.

MANHOLES IN KEELSONS.—Manholes with smooth edges to be cut in girder keelsons so arranged as to give easy access to all parts of the inner bottom and properly shifted on the different keelsons so as to leave the structure of the greatest possible strength. The size of manholes to be as large as possible for the easy passage of a man, but not to be greater than will leave a combined depth of metal in the keelson above and below the manhole of not less than two and one-half times the depth of tabular frame angle.

Section XI.—Inner Bottom Plating.

PLATING.—In all vessels for carrying bulk freight the tank-top plating, when no wood ceiling is fitted on top of the same, to be as given in Table No. 3, Part 2. It is to be riveted to the

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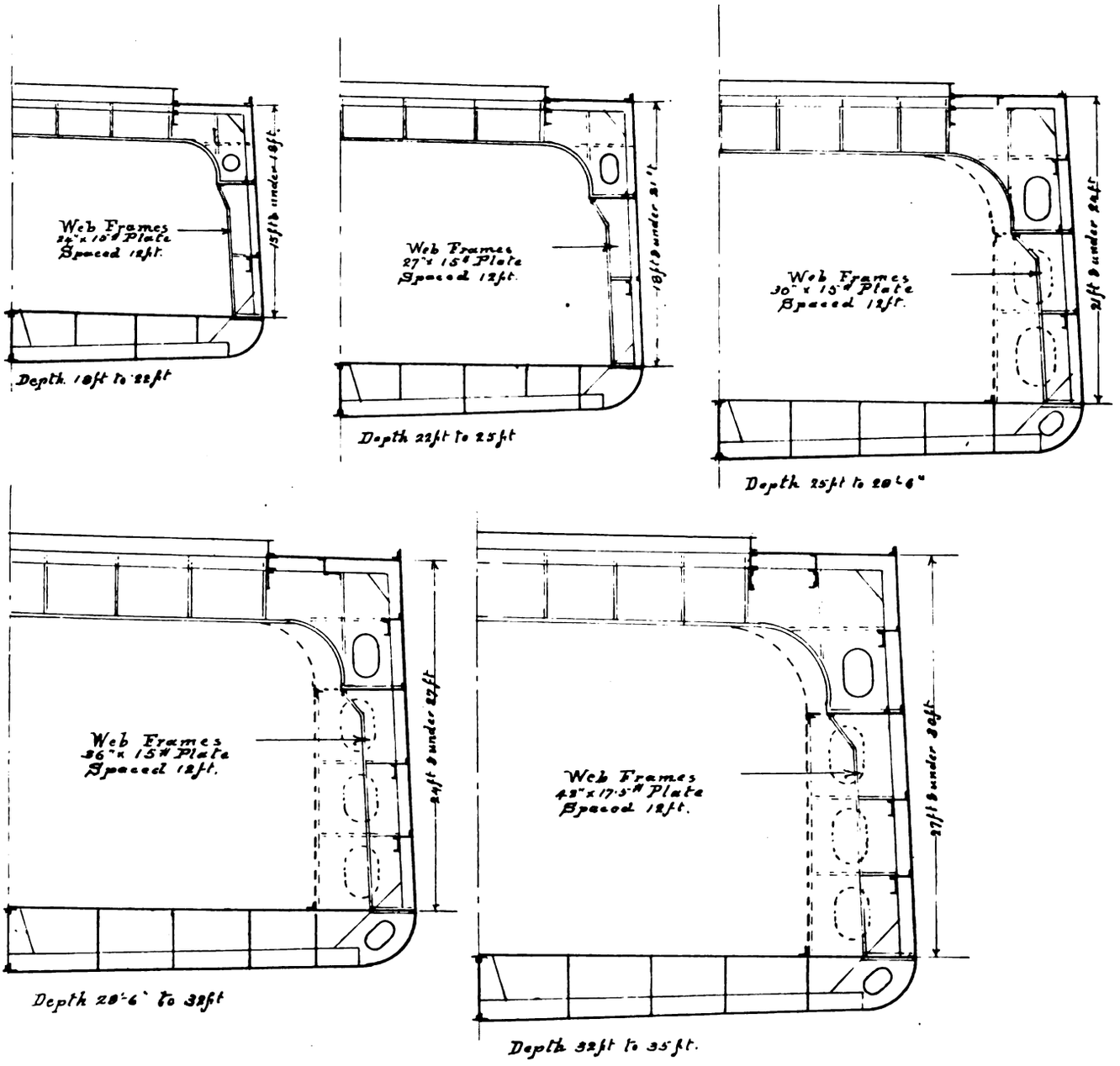

TABLE 6, PART 3. ARRANGEMENT OF SIDE STRINGERS, WEB FRAMES AND ARCHED PLATE DECK BEAMS WITH AND WITHOUT SIDE BALLAST TANKS.

angle bars on top of the center keelson and the side longitudinals, and fitted with angle stiffeners, as specified in Table No. 3, Part 2. A reduction of 15 per cent in thickness will be allowed on the plating between center and margin plates at the extreme ends of the holds and in bunker and other enclosed spaces where not subject to the action of heavy unloading machinery, and in all cases when wood ceiling is fitted over the tank top.

UNDER ENGINES.—The tank top plating under engine foundation to be 10 per cent in excess of tabular thickness for center-line plates but in no case to be less than 20 lbs.

CENTER LINE AND MARGIN PLATES.—The center line and margin plates to be run fore and aft, and butts strapped or overlapped and riveted, as per Table No. 6. The plating between the center and margin plates may be fore and aft or athwartships. If plated athwartships, all seams and butts to be at least double riveted. If plated fore and aft the butts must be either strapped or overlapped and double riveted, and fore and aft seams single riveted, as per Table No. 6. The margin plate to be connected to the side of the vessel by a continuous angle bar of size for upper angles of center keelson, or the edge may be flanged of proper depth to allow of double zig-zag riveting, as per Table No. 6.

STIFFENERS.—When wood ceiling is fitted over the tank top the plating is to be stiffened by angle bars, spaced not to exceed 4 ft., continuous from side to center line. Stiffeners to be properly riveted to the tank-top plating, to center plate and margin plate and also to the floor brackets at the center keelson, and by bracket plates to the vertical angles on the side keelsons and to the frames at the bilge under the margin plate.

STIFFENERS WITH NO WOOD CEILING.—In vessels carrying coarse bulk freight, such as iron ore and coal, with no wood ceiling on tank top, the stiffeners are to be spaced not to exceed 18 in. apart. Stiffeners in way of frame stations to be continuous from center line to side, riveted to

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main frames or bilge brackets and to center keelson brackets. Intermediate stiffeners may be continuous or intercostal between the keelsons, and must extend at least from the center keelson to lap on the margin plate, and connected by brackets to all side keelsons.

FASTENING OF WOOD CEILING.—When wood ceiling is fitted on the tank top, Z bars to be riveted to the tank-top plating over the tank-top stiffeners, and the ceiling spiked to wood carlings bolted to the side of the Z bars.

Section XII.—High-Water Ballast Compartments.

TOP PLATING.—Fore or after peaks, or compartments in holds extending to height of second deck, or side tanks for carrying water ballast, to be constructed of plating as for lower half of watertight bulkheads and properly stiffened horizontally and vertically as for watertight bulkheads to the satisfaction of the surveyor. Between the regular deck beams in every beam space an angle bar beam of equal scantling to main frame to be fitted. These to be connected to frames with hanging plate knees of equal thickness to the adjacent deck stringer. Said knees to be connected to frames and beams, with not less than six rivets in each frame and in each beam end.

TOP PLATING CONNECTION AT SIDE.—The top plating to be connected to outside plating with an angle bar of the scantling specified for 'tween and lower deck stringer angle bars which can be either worked around frames collar-fashion or continuous. If worked continuous, the frames in way of it which are cut to be connected to upper side of compartment top plating with bracket plates of the thickness and fastening specified for the plate knees of angle-bar stiffening beams fitted between regular beams, as specified in Paragraph 1.

END BULKHEADS.—The bulkheads at ends of compartments to have extra stiffening to the satisfaction of surveyor.

CENTER LINE BULKHEADS.—Water ballast compartments, except those at peaks, extending to lower or main deck beams, to have at middle line a fore and aft bulkhead, extending from keel to top plating; the plating of the bulkhead to be of equal thickness to top plating of compartment and be stiffened with angle bars of like scantling and spacing to those on watertight bulkheads.

Section XIV.—Deck and Hold Stringers.

ARRANGEMENT.—The arrangement of deck and hold stringers and hold beams to be according to construction adopted.

STRINGERS AT BEAM ENDS.—Stringer plates to be fitted at all deck and beam ends of width and thickness. Where on lower decks the stringer is cut for frames passing through, the clear width of solid plate inside of such cut must be equal to the width as specified.

MIDSHIP THICKNESS, LENGTH OF.—The upper-deck stringer shall maintain the specified midship thickness from a breast and engine space to beyond the forward cargo hatch. The lower deck and other stringers shall maintain the specified midship width and thickness for two-thirds the vessel's length amidships.

UPPER DECK STRINGERS WITH NARROW HATCHWAYS.—For upper deck stringers in connection with steel decks, when hatchways do not exceed in width one-half the width of the deck.

STRINGER PLATES OVER 80 INCHES WIDE.—When the required width of stringer plates is 80 in. and over, they should be made in two widths by a lap or seam strap joint at least double riveted. In the larger stringer plates this seam strap may be considered as a doubling plate and butts, strapped and riveted the same as on the stringer plates. All stringer plates made in two widths and connected by a seam strap must be carefully fitted, edge to edge, the same as for butt joints.

CONNECTION OF STRINGER PLATES TO SIDE.—All upper-deck stringer plates to be fitted close up to sheer strake and secured to same by angle bar of scantling fitted on top of the stringer plate, and the standing flange riveted to the upper edge of the sheer strake. Lower-deck stringer plates may extend to the shell plating by coping out for the frames, or have intercostal plates fitted between the frames and connected to the shell plating by flanging the plates or by angle bar clips.

GIRDERS UNDER DECK.—A continuous stringer or girder of similar construction and scantling to lower hold stringers to be fitted in line with the outboard edge of the hatchways, having intercostal plates fitted between the beams riveted to the upper-deck stringer plate and connected to the beams by angle lugs of side keelson angle scantling. In way of hatchways this stringer or girder to be worked in conjunction with the fore and after for short beams. Vessels whose breadth is 50 ft. or over to have two such stringers or girders, one fitted at the edge of the hatchways and one midway between that and the side of the vessel. The inboard stringer or girder to extend from the after end of the machinery space to the collision bulkhead, and the outboard one as far forward and aft as the shape of the vessel at the ends will permit. These girders must be continuous and butts connected as prescribed for butts and hold stringers, paragraph 15. Where the girders may be necessarily interrupted at bulkheads or deep-plate arch beams proper bracket plates must be fitted, to preserve the continuity of strength.

LOWER DECK AND HOLD STRINGER ANGLES.—'Tween and lower deck and hold stringer plates, in addition to the angle-bar clips for securing them at outside plating, to have a continuous angle bar riveted on their upper side at inside of frames. The reverse frames of two-deck vessels and of vessels with a hold string plate to extend high enough to allow being riveted to the continuous angle bar on lower deck or hold stringer plate.

CONNECTIONS TO HOLD BEAMS.—Hold stringer plates to be riveted to hold beams, and be further secured to same with gusset plates of equal thickness to adjacent stringer plate. The gusset plates to be fitted on the upper side of the beams and to extend well forward and aft of same.

HOLD STRINGERS OF CHANNEL SECTION.—Hold stringers of channel section must be fitted continuous in long lengths on the face of the frames or web frames and riveted to the same, having intercostal plates riveted to their upper flange, fitted between the frames and connected to the shell plating and to the frames or web frames by angle clips or the connection to the shell plating may be made by flanging the intercostal plate. When fitted over the face of the web frames, a continuous stringer angle bar also to be fitted at the face of the main frames on top of the intercostal plates.

SPACING OF HOLD STRINGERS.—When the spacing of the frames is 3 ft., the stringers are not to be spaced a greater distance apart than 5½ ft. throughout the body of the vessel, and at the forward and after ends, where, subject to panting strains and strains of the machinery, intermediate stringers must be fitted to the satisfaction of the bureau's surveyors.

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Section XV.—Deck and Hold Beams.

ARRANGEMENT. — The arrangement of deck and hold beams according to construction adopted, regulated by the depth of the vessel at location where fitted, measured at the side from top of floor plates, or from inner bottom in vessels having a continuous double bottom, to the top of the upper deck beams.

DEEP PLATE ARCHED BEAMS. — The arched girder beams spaced 12 ft. or 24 ft. apart to be of scantling as specified in Table No. 5, part 2. The girder plate to be of depth as given in the table, and the lower edge curved down at the sides, on a radius not less than two-thirds the depth, from the lower edge of the arch plate to the second deck stringer plate, the arch plate to meet the second deck stringer plate and be connected to same on its full width by double angle bars of scantlings, as for watertight bulkheads. The arch plate to be connected to the deck and side plating. The angles on the lower edge of the arch plates may be turned across the arch plate at the second deck stringer plating forming a connection to same; or, where web frames are fitted, they may be continued downwards to form the face angles of web frames, as specified in Section XVI, or connection otherwise made at the second deck stringer plate to maintain a proper continuity of strength, to the satisfaction of the surveyors. The wing plates of arches to be of same weight as wing plate of screen bulkheads in holds, and properly stiffened horizontally and vertically by angle stiffeners, as for bulkheads.

PLATING ON TOP OF ARCHED BEAMS.—The deck plating between the hatchways over arches to be laid athwartships and doubled for a width extending to the adjoining beams on each side of the arch beams, or a single plate 75 per cent heavier than tabular deck plating to be fitted over the arch beam and connected to the upper deck stringer plates by lap joint or butt straps, double riveted.

SIDE BRACKETS ON ARCH BEAMS.—Plate brackets of same weight as the plates forming the arches shall be fitted on each side of the arches to properly stiffen the same and support the deck beams on each side, spaced not to exceed 48 in. apart. They shall be of the full depth of the arches, flanged on their face; or, when arches are spaced 24 ft. apart, fitted with double face angles, connected to the arch plates and bottom angle of the arches by double angles. Double angles also to be fitted on the top edge of the brackets, and riveted to the lower flanges of the deck beams or connected to same by angle clips. Strap plates to be fitted at the meeting of the face angles with the hatch beams and the lower angles of the arches.

POSITION OF HOLD BEAMS OR WEB FRAMES.—Where hold beams are fitted in vessels having arch beams as above, the hold beams must be arranged coincident with the arch deck beams. Where web frames are fitted in lieu of hold beams, they shall be coincident with the arch beams as above, and fitted from the second deck stringer plate to the tank top or to floor plates in similar manner to web frames as specified in Section XVI. Web plates of 42 in. or over in width to be stiffened horizontally by angle stiffeners, as specified for divisional bulkheads, Section XXII, paragraph 10.

DEEP FLOORS IN CONNECTION WITH ARCH BEAMS. — In vessels fitted with arch beams and web frames as above, plate floors the full depth of the double bottom (with lightening holes cut in them) shall be fitted in line of all web frames; see Section IX, paragraph 5.

Section XVI.—Web Frames.

WEB FRAMES IN LIEU OF HOLD BEAMS. —In lieu of hold beams, as specified in Section XV, web frames of channel section or plate and angles, may be fitted, according to size and construction adopted. They are to extend from the floor plates or tank top to the lowest full tier of beams. Plate webs to have double-face angles of reverse bar scantling.

CONTINUITY OF STRINGERS. — Lower deck stringers are to be continuous through the web frames and the web frames fitted intercostally between them, or the stringers may be fitted intercostally between the web frames, provided that satisfactory connection is made at the webs with brackets and double-angle lug connections to properly maintain the continuity of strength to the approval of the board.

DIAMOND PLATES AT WEB FRAMES.—Where stringer angles are interrupted at the crossing of web frames, diamond plates of thickness 25 per cent greater than plate of web frames to be fitted to the face of angle bars on web frames.

HOLD STRINGERS WITH WEB FRAMES OF CHANNEL SECTION.—With web frames of channel section, the hold stringer to be a continuous channel riveted to the face of the web frames and having plate intercostals fitted between the web frames, coped out for the main frames, and riveted to the face channel and the shell plating, and also have an angle bar between the web frames fitted to the face of the regular frames, and riveted to the intercostal plates; or, instead of plate intercostals as above, these may be replaced by channels of depth equal to the difference between the depth of the main frames and the web frames fitted intercostally between the web frames, and short channel equal to the main frames fitted between the main frames, their flanges to be riveted together and the outer channel riveted to the shell framing, and the inner channel to be riveted to the reverse bars or inner flanges of the main frames and to the continuous stringer channel on the face of the web frame.

Relative Merits of Longitudinal and Transverse Types

J. W. Isherwood recently requested the firm of Bushell, Fletcher & King, of Liverpool, to pass upon the relative merits of the longitudinal and transverse type of vessels insofar as repairs are concerned. He received the following reply:

In accordance with your desire, I have gone carefully into the relative merits of the Isherwood longitudinal framed type of vessel, compared with the ordinary transverse framed type of vessel, under the following heads:

(1) The effect of damage and capability of the Isherwood type of vessel to resist same, as compared with the transverse framed type of ship;

(2) The relative costs of effecting the repairs to the one type as compared to the other;

(3) Expediency of repairs; and have to say:

In the course of my business as consulting engineer and naval architect extending over 30 years, I have supervised very many repairs of damage of every character and extent to the transverse framed type of vessel, and quite recently executed repairs to a ship of the Isherwood longitudinal framed type, the steamship Kendal Castle. This vessel was struck about 10 ft. about the stem on the starboard bow by a vessel almost "stem on," yet despite this the plating was not broken by the first impact but the colliding vessel had her bows crushed in and stem broken and set back at the upper

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part, the lower portion forming a "ram," glancing along the Isherwood vessel setting the shell plating and longitudinals in, until she came in way of the collision bulkhead when the broken stem of the colliding vessel pierced the shell plating in this range and tore away the collision bulkhead. From subsequent examination during the execution of the repairs:—

(1) I am of the opinion that had she been of the ordinary transverse framed type she would have been cut in between frames in all certainty to the center line, if not further, and would have necessitated extensive repairs to both bows and stems, if not the entire renewal of whole fore part of the vessel, but by reason of her longitudinal framing she was enabled to better withstand the crushing strains she was subjected to. Had the stem of the colliding vessel not been broken and formed a "ram" and pierced the shell I am of the opinion that the damage to the Isherwood vessel would have been of such a nature that temporary repairs could have been effected to enable her to proceed on her voyage.

(2) With regard to the relative cost of repairs to the one type as against the other, in my opinion the cost of repairs in the Isherwood type cannot exceed that in the ordinary transverse framed type of vessel; in the one case the range of the indent is over a somewhat greater area, but in the transverse framed type of vessel the number of frames and beams on each side and the probable damage to the stem bar would exceed the shell plating repairs in the Isherwood type vessel.

(3) The time consumed in effecting repairs to the Isherwood type of ship would in my opinion undoubtedly be less than in the transverse framed type, and I have the evidence of the case under review, where despite obstacles the work was effected in 11 days.

A VOICE CRYING IN THE WILDERNESS

IN THE *Engineering Magazine* for February, appears an article entitled "Engineering in the Navy, Its Organization and Efficiency," by Ira N. Hollis, a professor of mechanical engineering at Harvard university, and at one time an engineer officer in the U. S. Navy. Prof. Hollis, although long out of touch with naval activities, responds to the call for a forlorn hope to which the extremities of the present naval administration have driven it.

Space forbids reproduction of the entire article, but certain passages demand notice. Speaking of the effect of the absorption of the engineer corps by the line under the personnel bill, he says:

> The course at the Naval Academy quickly responded to the changed requirements for its officers and it became in every respect an engineering school equal to anything in the country. In one important respect, it is better than most other schools; men are there taught to do without question what they are told to do, so that some deficiencies in the curriculum are more than made up in the stern discipline which prevails over all.

This is a stock claim, not warranted by facts. It is a claim made only by people in the navy or people who, like Hollis, (formerly an engineer in the navy) do not know what they are talking about. It would be interesting to know the real opinions in this connection of the authorities of the Massachusetts Institute of Technology, Stevens Institute at Hoboken, Sibley College of Engineering at Cornell, or Rensselaer Polytechnic Institute at Troy.

> The law also allows, in exceptional cases, the warrant officers to obtain by examination and record the same commissions as those held by graduates of the naval academy. The navy is thus a thoroughly democratic institution and any fireman has the way open to a commission in the line of the navy if he has the ability, energy, and youth necessary to obtain it.

Yes—so has he the way to climb up the outside of the Washington monument. He is about as likely to do that as get a commission in the navy under present conditions. It should be possible to quote at least a few instances wherein this provision has been availed of a fireman. There are two answers: one that the ability is nonexistent, which is not true; and the other that academy graduates discourage and oppose those seeking a commission except by the academy route, which is the truth.

> If the staff managing a power station were required to design and build its own machinery in addition to operating it, there would be an excellent parallel between the conditions on shore and those on board ship.

This is, indeed, an excellent parallel and shows the absurdity of Hollis' position. Where is there a power station whose *staff* designs and builds the machinery, instead of competent experts?

> The orders issued by Secretary Newberry during his very brief term of office reorganized the navy yards by placing all work under the immediate management of a naval constructor. This was a distinct improvement. The old system of having as many heads as there were bureaus at the navy department, with very imperfect co-operation, was wasteful and slow. Furthermore, it was used as a means of giving officers shore duty, not selecting them for their special ability but because it was their turn to have relief from sea service.

This is very misleading in view of the fact that Mr. Newberry had control of the navy yards during the three years that he was assistant secretary of the navy, and continued his direct control when he assumed the office of secretary. But, doubtless all unwittingly, Prof. Hollis here touches the sore spot and discloses why "the order went too far and aroused intense antagonism throughout the entire service." At last we have it! The fiery patriotism of the sea dog and his determination not to be separated from the swivel chair and the flesh pot.

> But, with all the arguments in favor of the new system, (promulgated over night) granted, the organization was too hasty and its effect was to throw out of work, and effective control of work, a large number of men fully as able to direct navy yard operations as the corps of constructors. This naturally aroused intense opposition.

The use of the words "promulgated over night" is apparently borrowed from the statement issued by some mutinous officers attached to the Panther while at the Philadelphia navy yard, shortly after Mr. Newberry retired from the department, and this statement is absolutely false and evidently intended to convey the impression to the reader that the changes in the administration of the navy were made in haste, without consideration and under cover of darkness, the fact being that the consolidation of shops and work in the navy yards had been experimentally tried for many months at Charleston before it was actually put into effect in all of the larger yards. The plan had been discussed by Mr. Newberry in the formal hearings before the house committee on naval affairs, had been presented to the president and by him referred to a board composed of the following gentlemen:

Hon. William H. Moody, ex-secretary of the navy.

Hon. Paul Morton, ex-secretary of the navy.

Hon. A. G. Dayton, ex-member of the house naval committee.

Rear Admiral S. B. Luce, U. S. N., Ret.

Rear Admiral A. T. Mahan, U. S. N., Ret.

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Rear Admiral R. D. Evans, U. S. N., Ret.

Rear Admiral Wm. M. Folger, U. S. N., Ret.

Rear Admiral Wm. S. Cowles, U. S. N., Ret.

who presented the following report:

Navy Department, Jan. 15, 1909.

Report of a conference convened to advise the President concerning the temporary plan to improve the administration of the navy department, and also to suggest measures to procure a permanent reorganization which shall perfect the fighting efficiency of the navy:

Resolved: It is the sense of this meeting that the plan of administration of the navy department proposed by the secretary in his communication addressed to the President, under date of Jan. 12, 1909, *is the very best thing to be done temporarily.*

Furthermore, that there should be a commission appointed to prepare and recommend a plan for the permanent reorganization of the navy department, with a view of increasing the general efficiency of the navy.

Furthermore, that we believe that such a commission should originate by Congress authorizing and requesting the President to appoint it.

WILLIAM H. MOODY,
PAUL MORTON,
ALSTON G. DAYTON,
S. B. LUCE,
Rear Admiral, U. S. N.
A. T. MAHAN,
Rear Admiral, U. S. N.
WM. M. FOLGER,
Rear Admiral, U. S. N.
WM. S. COWLES,
Rear Admiral, U. S. N.
WILLIAM E. FULLAM.
Comdr. U. S. Navy, Secretary.

Prof. Hollis evidently shares with many others, inside the department, the bias which prevents stating the truth. The recommendation which we have italicized meant of course under existing law. As to the capable men displaced, who were they, and where are they? They are not directing work under the Meyer organization. Mr. Meyer shed crocodile tears before the naval committee because electrical work, previously under experienced commanders, etc., had been turned over to youthful and inexperienced constructors. When he abandoned the Newberry organization, this work was not returned to the *experienced* officers, but put in charge of young line officers of demonstrably less experience than the young constructors from whom the work was taken.

Mr. Newberry's order utterly failed to take into account the immense educative value of placing engineering officers directly in control of repairs to machinery on shore.

As the early Christians were butchered to make a Roman holiday, so the machinery of our men of war, a vital element of our national defense, is to be handed over to incompetent shop managers to give them a smattering of mechanical knowledge.

As a matter of fact, the order did take account, and fully, of that very thing and of its wretched failure. This is the first time, however, within our observation, when this argument has been publicly advanced. It might have been kept in the background, however, since the Meyer entourage, and Hollis himself insistently claim that the line officers already possessed expert knowledge and, in fact, were better equipped than the construction corps for yard supervision.

Another objection to the new order was that it established a divided responsibility. It was claimed in argument against this that the sea-going officers were made inspectors of the work done under the direction of a naval constructor and that they thus became responsible; but it was at best the establishment of another link certain in a short time to prove weak.

How did it establish a divided responsibility? It did no such thing. As to the "link certain in a short time to prove weak," if there is one fact established by experience, it is that the best possible results will be attained in repair work when it must be done to the satisfaction of the person who is to use the repaired appliance, and the latter person has no direct or indirect interest in the personnel engaged in or methods of doing the work but only in the results. The recent order of Rear Admiral Leutze at the New York yard much praised) by which all work on board ship is inspected by the ship's force, is simply a return to one of the essential features of the Newberry system which Hollis is here attacking.

One of his (Secretary Meyer's) earliest official acts was a frank acknowledgement of ignorance on technical matters by the appointment of a board to study and report on the organization of the navy yards.

If this refers to the "Swift" board, it is a very inadequate statement of its functions, which were avowedly to re-organize the navy department. Its work in connection with navy yards was rather a side issue.

He simply left the hull work under the constructors and he placed the repairs to machinery where they belonged, in the management of sea-going officers.

A very large part of the hull work is now being done at navy yards under direction of sea-going officers. The yards are divided by shops, not by duties. Shops under the machinery division do much hull work, those under the hull division practically no machinery work.

The third step related to the bureau system at the navy department, recommendation being made to congress that the bureau of equipment be abolished and that its work be divided amongst the other bureaus. A bitter fight followed this recommendation, as the secretary, after investigation, had decided to place a large part of the electric machinery under the bureau of steam engineering, whereas the bureau of construction wanted it.

Also that a large amount of work under the bureau of construction and repair be taken away from it.

There is something almost grotesque about this squabble among serious minded officers, as either bureau was amply competent to install it. Neither, in the nature of things, could have much to do with its manufacture and the secretary showed his good judgment by giving its selection and installation to the officers who were to operate it.

Prof. Hollis pays such officers a high compliment in calling them serious-minded. It savors much more of the kindergarten. It is a fundamental principle of sound organization of the naval service that the man who operates an engine, gun, or other appliance should *not* be the man who designs, builds and installs it. This identical principle is much harped on by Mr. Meyer, who points out as a fundamental fault of the old system that the bureaus who did work also reported upon it. The Meyer organization, however, in many places is directly counter to the fundamental principle which he invokes only when it serves his purposes.

The fourth step taken by the secretary was the appointment of four aides to advise him on all matters pertaining to the service. The only one of these concerned directly with engineering was the aide on *material*, and Mr. Meyer's obvious intention was to obtain advice from an experienced officer on the conflicting claims of bureau chiefs. The system of settling these claims was at best a makeshift; it simply referred them to a board consisting of the officers who made the claims.

This is not so. The board on construction under the Newberry organization consisted of *four* chiefs of bureau and *five* other officers having no connection with the bureaus, and included seven line officers and one staff officer. If there is anything at all obvious, it was to entirely discredit the staff and exalt the line officers and provide numerous additional shore berths for them.

Strenuous Life of Military Advisers.

While it was a fatal error of previous administrations to have officers who had charge of work report on it, it is observed that Mr. Meyer fortified his testimony before the naval committee this year by statements from his aids pointing out what fine fellows they are and what a great work they are doing. The aid for material gives an appalling total for the number of papers passed through his office but modestly admits that they are mostly routine, requiring no military knowledge. Application of arithmetic to the statistics of the aid for material discloses the fact that in

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this office the military officers handled on an average some *three papers per diem.* Such is the strenuous life of the military advisers of the navy department under the Meyer regime.

The secretary's report shows at least that his plan has worked well for six months and that there has been a large resulting economy in naval expenditure.

The secretary's report makes a claim—it demonstrates nothing. The claims of economy *resulting from the Meyer plan* have been fully exploded by the House Naval Committee. When discussing the naval bill in the house Mr. Padgett, the prospective chairman of the naval committee in the next house, simply riddled the grossly misleading and erroneous figures put forward by Mr. Meyer in an attempt to demonstrate economy by the Meyer plan. It remains to be seen whether the "officer and gentleman" who prepared these figures for Mr. Meyer will be court-martialed for practicing deception. Mr. Padgett made it perfectly evident that deception had been attempted. The situation is now up to the secretary of the navy.

We have had eleven years of experience with machinery since the passage of the personnel act. On the whole, it has worked well and officers generally are satisfied. The first need seriously felt as the older engineers dropped out, was for designers of machinery and for highly trained technical men to direct the construction of machinery, all of them selected from the line of the navy. This need has been supplied by another of Secretary Meyer's orders in the establishing of a post-graduate course in engineering at the naval academy. Ten officers are selected every year and the course covers two years in all branches of engineering commonly practiced at sea. There are thus twenty officers under instruction at the naval academy. The first class of ten was selected in the fall of 1909 from about two hundred applicants for the instruction. From these classes, two will be taken every year for designing machinery and superintending its construction. The course of studies is highly practical, including the summers spent in the inspection and study of industrial processes at various large commercial establishments. While the space of this article does not permit a statement of details, it may be said that the course covers a consistent study of engineering and time is found for lectures by a number of experienced civilian engineers, manufacturers, and teachers.

Hollis is a professor at Harvard and can know little about the opinions of "officers generally." He was a very strong advocate of the personnel act of 1899 and is not a disinterested critic. Whether the officers are satisfied or not is beside the question. They are not paying the bills nor are they disinterested.

This naval academy course, regarded as a serious engineering course, is a joke. There is no course. A library of engineering literature is provided and the officers are turned loose in it to study what they please. They also listen to a lecture once a week or even twice a week in particularly strenuous times. No wonder there are plenty of applicants for this wonderful "course." Applicants for "soft billets" are always numerous in the navy. The post graduate course in engineering was established by Mr. Newberry. Mr. Meyer simply changed it from a suitable place—the Massachusetts Institute of Technology—to an unsuitable place—the naval academy.

Specialization is certainly the tendency of the day. It is required in the trades, and what is more it is thoroughly practiced in the *enlisted* force of the navy.

The italics are ours. Prof. Hollis is defending a policy which is the antithesis of specialization and the acme of generalization, inferior at that; yet he realizes the value of special knowledge and looks to the enlisted force to supply it, not the officers who are supposed to have been educated to that very end.

Shameful History of Pacific Squadron.

It is, beyond question, due only to the presence of the warrant machinists, who are competent engineering specialists of the class that run merchant vessel machinery, that we have not utterly failed as regards machinery operations on board ships of late years. The commissioned officers have failed lamentably at every point. Only recently the battleship Indiana was crippled, and her starboard engine wrecked, in the Mediterranean because of the inability of an engineer officer to compound the engine—i. e. convert from a triple expansion to a compound by cutting out one stage. He pleaded in extenuation that it was *a very difficult and intricate operation requiring special knowledge.* Yet there is probably no bright engineer in the merchant service who would have had to even pause to give the job a thought unless he were standing his first watch in a strange ship. The shameful history of the Pacific squadron and the monstrous fabrications given out by its officers to cover up the real state of affairs have been heretofore published in THE MARINE REVIEW and the disclosures have never been and cannot be denied.

A slight examination of the records during the past few years will demonstrate the complete success of the present organization. In the matter of coal consumed on board ship, it may be assumed that lack of efficiency would appear in a much larger coal bill, yet the past few years have shown a steadily decreasing expense.

A brief table of three classes of ships affords a very fair comparison in this respect. They are all figured on the coal per indicated horsepower, thus eliminating the size of the ships and their speeds from consideration. There are three classes set down in the table: the first represents the average for ships commissioned during the past five years; the second for those commissioned in the 90's; the third for those of the 80's.

It is only fair to state that the machinery for all these ships was either designed or inspected by officers of the old engineer corps, but the ships of the first group have been operated entirely under new conditions by line officers who certainly show no falling off in the economical expenditure of coal. One of the most effective systems for promoting efficiency in this regard is the offering of prizes for economy and coal efficiency in the engine-room department. This began on the battle ship cruise around the world. It encourages the same zeal in the fire-room as is produced on deck by prizes for the best target practice.

It is difficult to make reliable comparisons on the cost of repairs to machinery and boilers. Testimony before a congressional investigating committee on the merchant marine shows that the annual cost of repairs to machinery on merchantmen exceeds 9 per cent of the value. Expenditure for similar purposes in the navy is only 2 per cent of the value. This great difference is probably due to the fact that the enlisted force can do a large part of the repairing on board ship, in which case no charge for wages is made. The warrant machinists are leading men for the repairs which are always under the supervision of an officer.

Ships of 1905-1910.

	Coal per i. h. p.	Speed.
North Dakota	1,739	21.66
Flusser	1,923	30.41
Michigan	1,690	17.95
South Carolina	1,395	18.86
Birmingham	1,932	24.32
	1,736	

Ships of 1890-1900.

	Coal per i. h. p.	Speed.
Indiana	2,023	12.08
San Francisco	2,003	19.52
Oregon	2,150	16.791
Olympia	2,190	21.68
Baltimore	1,707	20.09
	2,015	

Ships of 1880-1890.

	Coal per i. h. p.	Speed.
Chicago	2.63	15.13
Concord	2.76	15.8
Dolphin	2.19	15.5
Boston	3.11	13.8
	2.67	

Another statement which illuminates this side of the question is that the total engineering expenses in 1907 for each horsepower in the navy, were $6.04; in 1908, $4.39; in 1909, $4.31; in 1910, $3.97. The coal for steaming purposes per knot including tugs, colliers, and torpedo craft was: 1907, 1,027 pounds; 1908, 801 pounds; 1909, 755 pounds; 1910, 740 pounds.

The casualty list and breakdowns cannot easily be compared with the same things in the old navy, or under the old system of a separate engineer corps. The ships are so utterly different and so vastly greater in power that there is no basis for comparison.

Comments heretofore have had to do mainly with statements which, though garbled, biased and inaccurate, might have been honestly made and in many cases are opinions. Unfortunately for himself, Prof. Hollis has here ventured into the realm of figures which, it should be remembered, are put forward with the weight of Prof. Hollis' professional reputation. It is, then, with astonishment that we note the nature of the statistical information brought forward. He contrasts an alleged annual repair bill of 9 per cent of machinery values for merchantmen with 2 per cent in the navy. He does not state where he gets this 2 per cent, though he admits it is low, due to the fact that, in the navy, many repairs are made without being charged as such.

But neither Prof. Hollis or any other, in or out of the old or the new navy or under any administration,

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ever saw or heard of any naval ship, big or little, which escaped with a 2 per cent annual repair charge.

A Foolish Statement on Repair Charges.

It is impossible to believe that Prof. Hollis makes this statement in good faith. Even with the worthless and deceptive figures prepared under the naval system and which ignore all those charges except direct labor and material which are included in the merchantman's costs, and even making allowance for all the work done by the ship's crew and all other allowances and jugglings that can be hooked or crooked into the statement, there cannot be produced the record of a single ship say ten years old, showing an average annual machinery repair charge as low as 2 per cent of the cost of the machinery. Prof. Hollis has made that statement; he is invited to prove it. There are numbers of our naval vessels in which the entire boiler installation has been completely renewed in ten years, to say nothing of the repairs during that time. But the engineer's force does its share of repair work without doubt. One of the "confidential" bulletins issued by the department as a "new" feature is quoted at length to show the organization for carrying on work on the battleship Michigan. If one may judge from this, it would seem that the primary function of the force is to repair the machinery, not to operate it.

But Prof. Hollis' repair bill comparison between naval and merchant vessels is, moreover, of a specious character, which ignores utterly an obvious cause for difference, of which he could hardly have been unaware. Repairs are due mainly to the wear and tear of service, and the service is many times more strenuous in the merchant service than in the navy. The Atlantic liner, for instance, will make in a year twelve or more round trips, steaming in the course of a year 75,000 to 90,000 miles at full power through fair weather and foul, and does it year after year.

The following table is compiled from reports of the secretary of the navy:

Fiscal year ending June 30	1908	1909	1910
Total miles steamed by all battleships in commission	286,820	568,229	108,213
Number of battleships in commission	22	22	21
Average miles steamed by battleships per year	13,037	25,830	5,153
Average miles per ship per day	35.7	70.7	14.14

This is a handsome showing on which to base comparisons with the merchantman! The high figure of 1909 was, of course, due to the "world cruise," concerning which so much ink has been spilled and so much rubbish talked.

Moreover, the battleship, like practically all naval vessels, does nearly all of its steaming at reduced power, very seldom proceeding at as much as one-fourth of its full power. The comparison between navy and merchant repair bills which ignores the essential difference between the service explained above may certainly be characterized as specious, even if we accepted the figures.

Figures Subject to Suspicion.

We shall soon see that the other figures put forward by Prof. Hollis are also subject to grave suspicion. Prof. Hollis' comparison of coal for steaming purposes for various years is hardly of the kind one would expect from an engineer of scientific attainments. The average per knot is taken of all vessels, "including tugs, colliers and torpedo craft." Of course, as an arithmetical proposition, averages are easily struck, but what is the engineering significance of an average consumption where the 20,000-ton battleship and the 100-ton tug or torpedo boat are lumped on even terms in unknown numbers? If Prof. Hollis can draw any sound engineering conclusion from such averages, he is, without doubt, the only reputable engineer in the world who can do so.

In this same paragraph is given a comparison of engineering expenses based upon horsepower. If this basis is the total horsepower of all ships on the navy list, it is valueless and misleading because the total horsepower of ships on the list between 1907 and 1910 has increased in a greater ratio than the expenses have diminished, assuming Hollis' figures to be correct, and, if the basis is that of ships in commission, then the figures are still more misleading because the power of the ships in commission in 1910 is vastly greater than that of the year 1907.

And, after laboriously constructing his case, Hollis himself destroys it by saying that "the ships are so utterly different and so vastly greater in power that *there is no basis for comparison.*"

Prof. Hollis rather evades the question of casualties and breakdowns. Perhaps the less said about such unpleasant subjects the better. His article was, of course, written before the recent disastrous boiler explosion on the Delaware. The fact that the killed on that occasion were all enlisted men and did not include even a midshipman lends color to the contention of those who believe that line engineering is largely farcical and the great majority of line officers shirk the disagreeable jobs, such as fire-room watches. Careful scrutiny of the organization for carrying on work and operating the machinery of the Michigan discloses no reference to fire-rooms and boilers.

Speed of the Fleet.

In connection with this subject a little news item in the papers of February 4th sounds a disquieting note. It was evidently given out by the navy department and represents Admiral Schroeder as explaining that the reason his fleet was detected by Admiral Staunton's scouts on its recent passage across the Atlantic was that his fleet had to steam at 12 knots because the Virginia could not maintain the 13 knots planned for. The Virginia made over 19 knots on trial and to make 13 would need to develop only about one-third of her full trial power. The evolution was widely touted as being carried out as in time of war. Are we to conclude that in war time our crack battleship fleet will have a speed of 12 knots only? The speed of a fleet is the speed of the slowest member of it.

Take up, finally, Prof. Hollis' star exhibit where he demonstrates engineering efficiency by the steady falling off in coal consumption per indicated horsepower. The use made of the tables is unworthy of a man of Prof. Hollis' standing, as the greenest engineering student will know that recent engines are, per se, more economical than engines of 30 years ago and are so much more economical that they would still show higher economy in spite of inefficient handling.

But here Prof. Hollis commits an offense graver than the violations of ethical standards of engineering. He says: "In the matter of coal consumed on board ship, it may be assumed that lack of efficiency would appear in a much larger coal bill, yet the past few years have shown a steadily decreasing expense. The ships of the first group have been operated entirely under new conditions by line officers who certainly show no falling off in the economical expenditures of coal."

If English words mean anything, the language used by Prof. Hollis means that the coal consumptions given for the first group of five ships were obtained when they were being "operated" by "line officers." Yet it

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is a fact that *every figure given by Prof. Hollis for the first group of ships* (1905-1910) *is the result of contract trials where the ships were operated by the builders.*

Any one interested can find the figures in the reports of the contract trials of the various vessels in the *Journal* of the American Society of Naval Engineers. The figures for the North Dakota, Flusser and South Carolina will be found in Vol. XXII, No. 1, published in February, 1910. The figures for the Michigan are in Vol. XXI, No. 3, published in August, 1909; and for the Birmingham, in Vol. XX, No. 3, published in August, 1908.

Further investigation will show that for the second group of ships *all the figures given except for the Indiana are also from results of contractors' trials,* and probably the same is true for the last group.

For the first group the results all apply to the full power four-hours trial, except for the Michigan, where, for some reason, the results are for the 24-hour trial.

However it may be explained or excused, it is a patent and obvious fact that Prof. Hollis in his statements above quoted has borne false witness. When methods such as these are used to defend present conditions, they must, indeed, be in need of defense.

Lake Ship Building

The American Ship Building Co. will build the new steamer City of Detroit for the Detroit & Cleveland Navigation Co. from designs by Frank E. Kirby. The new steamer will be one-third larger than the City of Cleveland, which attracted so much attention when it came out a couple of years ago, and will be the largest side-wheel steamer in the world. The new steamer will be 472 ft. in length or 68 ft. longer than the City of Cleveland, and will have sixty-two more staterooms than the Cleveland has. The decorative features will, as usual, be entrusted to Louis Kiel. All of the unique features incorporated in the City of Cleveland will be found in the new boat, as well as many new ones. These, of course, include a passenger elevator, sprinkling system for emergency purposes, wireless telegraph, convention hall, palm garden and open fireplace in the lounge. Telephones will be installed in every stateroom, and what the traveling public will most appreciate, running water in every stateroom. There will be twenty private parlors with bath and private verandas.

The Great Lakes Engineering Works has obtained contract from coal interests in New England for the construction of four colliers for ocean service. The colliers will be 257 ft. long and 43 ft. beam. The boats will be built under the survey of the American Bureau of Shipping.

The Great Lakes Engineering Works has also disposed of, to the same interests, the seven whaleback barges which it took from the Pittsburg Steamship Co. as part payment for the new steamers William B. Dickson, W. J. Olcott and William P. Palmer. These barges are known as No. 117, 118, 130, 131, 132, 133 and 134.

The 600-ft. steamer building for the Jones & Laughlin Steel Co. of Pittsburg, intended to replace the W. C. Moreland, which was wrecked on Eagle River, Lake Superior, last fall, will be named in honor of Thomas Walters, Ishpeming, mining expert for the Steel Co. The new steamer will be launched about April 15, and will be ready for business about a month later.

It is announced that the Mackinac Transportation Co. will shortly solicit bids from the ship yards for the construction of a car ferry to operate in the Straits of Mackinac. The plans call for a steamer to be 352 ft. long and 60 ft. wide with capacity for 25 cars.

The Booth Fisheries Co., of Chicago, which built four tugs last year named the Cincinnati, Louisville, Chattanooga and Nashville, has given contract to the American Ship Building Co. for four duplicate tugs. They will be built at the Lorain ship yard.

Two dump scows are being built for the Great Lakes Dredging Co. at the plant of the Western Dry Dock & Ship Building Co. at Port Arthur, which is controlled by interests associated with the American Ship Building Co.

Put-in-Bay is the name selected for the new steamer building at the Wyandotte yard of the American Ship Building Co. for Ashley & Dustin, of Detroit. The new steamer will be launched on March 18.

The American Ship Building Co. has taken contract to build a sand sucker for upper lake interests to be 165 ft. over all, 152 ft. keel, 36 ft. beam and 10½ ft. deep.

It is announced that the Northern Navigation Co. will shortly solicit bids for the construction of a new passenger and freight steamer somewhat larger than the Hamonic.

The American Ship Building Co. is building a catamaran for service on Silver lake.

Dispatch in Loading and Unloading Lake Vessels

Herewith is published a comparative statement for the years 1906 and 1910 showing the average stay at upper and lower ports of the vessels of the Pittsburgh Steamship Co. It will be noted that dispatch has improved wonderfully during the four years, practically cutting in half the time lost in port. The surprising feature is the increase in efficiency of the loading docks. It was, of course, to be expected, that the unloading docks would show greater efficiency because they have undergone extensive development of late years but that the loading docks should have attained an ever greater percentage of efficiency is quite remarkable. The average cargo shows an increase of about 700 tons. The actual increase is probably greater, as 1910 was a year of short cargoes, owing to low stage of water. Following is the table:

	Year. 1906.	Year 1910.
	hr. min.	hr. min.
Average stay in lower lake ports	36 15	22 22
Average stay in upper lake ports	22 25	12 22
Average time spent in port receiving and discharging cargoes	58 38	34 44
	Gross tons.	Gross tons.
Average cargo carried	5,954	6,634
Largest cargo carried	13,333 In 70 min.	13,296 In 45 min.
Fastest loading record	9,277 Tons. per hr.	9,788 Tons. per hr.
Rate of fastest loading record	7,288	13,051

Growth of Lake Tonnage

Herewith is given a table showing the growth of lake tonnage by decades and also graphically exhibiting the growth in carrying capacity and expedition in loading and unloading. The largest steamer for each decade is selected, the Matoa for 1890, the John W. Gates for 1900 and the J. Pierpont Morgan for 1910. Following is the table:

	Str. Matoa, 1890.	Str. John W. Gates, 1900.	Str. J. Pierpont Morgan, 1910.
Length over all, ft.	290	500	600
Beam, ft.	40	52	58
Depth, ft.	21	30	32
Registered tonnage, gross tons	2,311	5,085	7,161
Draught of water in channel, ft.	15½	17¾	19.7
Average cargo, gross tons	2,500	7,000	10,526
Average loading time, hrs. and min.	15:00	20:00	12:52
Average unloading time, hrs. and min.	36:00	43:00	16:21

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Confusing the Issue

Never in the history of the United States has one of the great departments of its government been in such desperate need of defense as the navy department under its present administration, and never has the country seen such press-agent activity in support of a great arm of the national service as that now in evidence; nor, probably, has there ever been such deliberate untruth, such specious and misleading statements, such distortion of facts and cheap notoriety-seeking coupled with the discrediting of able and conscientious men who either would not submit to being placed in false positions or were not in position to defend themselves, as now manifested in support of Secretary Meyer and his masters, the line organization. For Secretary Meyer is not master of the navy department; he merely thinks he is, and the general public of course assumes him to be. As a matter of fact, he is bound to the chariot wheels of the line officers; he speaks as they tell him; he acts as they direct.

The administration of the navy department has been scandalous for years. The first secretary in a generation who brought to his position other than a legal or banking or political training, Secretary Newberry, discovered and promptly proceeded to cure, the lamentable ills, but unfortunately his term of office was all too brief. There can be no doubt whatever that if he were to speak of what he actually found the public would be lost in unbelief. What he did accomplish with his limited opportunity, however, created nothing less than a panic in the department. A more plastic and less scrupulous secretary must be found and that the frantic search was successful there is no lack of evidence.

Elsewhere we have dealt with an article in support of the Meyer regime by a gentleman from whom his professional position would have warranted the expectation of better things, but more recently has appeared an unsigned contribution to another magazine* which is, if possible, even more grossly inaccurate and misleading.

The author loses not an instant in glittering generalities; his opening paragraph contains an untruth. He says:

> In the same year (1908) the fighting officers of the American navy—after several years of effort—succeeded in informing the American public that its ships were backward in design, not properly armored, and that in some respects their fighting machinery was very dangerous to operate.

Passing over the fact that THE MARINE REVIEW had long before called attention to the scandalous maladministration of the navy, the "fighting officers" did nothing of the kind. The bloodthirsty crowd in fact scouted the suggestion and a board of sea-going officers appointed by President Roosevelt to investigate the charges of faulty design (which came from without the navy) gave the navy a clean bill of health. One officer after another hustled into print to tell what a splendid machine the navy was. Admiral Brownson, Admiral Evans (also a "fighter" by brevet), Admiral Melville and others, in picturesque language, (the "fighting" officers' language is always garnished), told how our navy was "the equal of any."

And, most wonderful of all, in the "great cruise" *there was not a battleship that had even been authorized later than 1905.* Our readers may perhaps recall that "matchless fleet," that "epoch-making performance," that "object lesson to all the world," that "eye-opener to other nations." Even the Michigan and South Carolina, which Sir William White, late chief constructor of the British navy and who has designed more naval vessels than any other man, living or dead, and probably more than all living designers together, said in a recent paper* were the best examples of the fighting ship yet designed, were authorized and begun some time before the "fighting officers" made their alleged discovery. So much for that.

Mr. Meyer's eminent qualifications for a naval secretary are shown to be based upon his observation of the "great Russian-Japanese sea campaigns" from his post of ambassador at St. Petersburg, where he could look out of the window and watch the daily (?) encounters in the Japan Sea

*McClure's, March, 1911.

*Proceedings Am. Soc. N. A. & M. E.

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over 9,000 miles away. His claim as a far-seeing official are admitted. But we must get on.

The ship of a modern navy is simply a collection of machinery—one of the most intricate collections of machinery in this mechanical age.

The education of all the military officers of the navy is now based upon this fact; they are given—besides their training in navigation and seamanship—a wide, sharp, and thorough technical education as mechanical engineers. The whole theory of their development is that they should be first educated and then trained in the practical handling of the machines of their professions—steam machinery, electrical machinery, the mechanism and chemistry of gunnery.

The duties of the men under them grow more and more mechanical. On the newest ships one-third of the crew are firemen and coal passers.

This claim as to engineering and mechanical education is constantly made and is utterly without foundation; it is a plain falsehood, designed to create an erroneous impression. We have dealt with this same point elsewhere. The statement as to the number of firemen and coal passers is also incorrect.

For thirty-five years the military branch of the American navy had been trying to overthrow the bureaucracy which ruled it—with very small success. * * *

The military branch was unorganized, while the organization of the bureaucracy was most effective and complete. * * *

The navy was formed in 1842, and it was fully organized on the basis of the sailing ship with supplementary steam machinery. As new mechanical inventions had arrived, they had been given to various bureaus. But the principle was unchanged, and as late as 1904 these bureaus insisted on the building, at a cost of $1,249,389, of two iron sailing vessels and a wooden brig, for the training of American gun-pointers—vessels which, of course, have never yet been used.

There were eight of these bureaus, with chiefs appointed by the secretary of the navy, approved by the president, and confirmed by the senate.

Of the eight bureaus all except construction and repair and of yards and docks are, and have been, under the direction of line officers—the military branch. The effort is consistently made to create the contrary impression. The building of the sailing ships referred to was at the direct instance of the bureau of navigation, headed by one of the "fighting" officers. Of course they are valueless, and the money they cost is wasted, but the attempt to make the non-military bureau chiefs responsible is paltry and specious.

By 1909, $69,000,000, two-thirds of the naval appropriation, was being spent on land.

This was not all. By 1909 a new plan was under way—a definite move to center the expenditure of the money spent on land permanently in the hands of a non-seagoing bureaucracy. The chief land bureau was the bureau of construction and repairs, operated by the naval constructors—the one special class of the three branches that is now separate from the general body of the military officers who serve in the fleet. The naval constructors are not military men, but designers of ships. * * *

In 1908, the operation of all the navy yards was practically given into the charge of the bureau of construction and repairs. * * *

The net result of this movement, if continued, would necessarily have been the placing of two-thirds of the naval appropriation permanently in the hands of an unmilitary class. * * *

In 1909, Secretary Meyer announced his plan for a military navy. The aim of a navy, he believed, is to become a successful fighting machine, always ready. A successful fighting machine can be secured only by means of a thoroughly trained body of fighting mechanical engineers. This was the foundation of the Meyer scheme.

The secret is here. The sea-going officers wanted shore berths and the handling of the money. That's where the "fighting" is required. Where are these to acquire the knowledge of ship design and construction to fit them for navy yard management? The constructors were properly in charge of this work and the fighting branch have no business with it. The new scheme provides nothing whatever except an intercepting line officer between the secretary and the bureau chief and takes the machinery division from the manufacturing department, presided over by a constructor as manager, and gives it over to the exclusive control of the bureau of steam engineering with a line officer as chief.

It is a beautiful provision for enabling the engineer force to bury their own mistakes and cover up their failures, a convenience of which they stand in sore need. The navy is no more military than before in the true sense. A line officer is placed over construction and repair but designing must in the end be done by the non-sea-going staff just as heretofore. The efforts of sea-going officers to influence design are well known. They cannot and never have been able to agree on what was the proper thing. The designs of some of our ships have been changed over and over again, even after construction has begun, to suit conflicting views of different groups of "fighting officers." The Tennessee is an instance. A line officer is in charge of inspection. How an officer without practical, or even technical, knowledge of materials or construction, assisted by others equally well informed, helps to a military navy is not clear.

The first consideration of a modern military body is its weapons, and the weapons of a navy are its ships. The ships of the American navy had been designed, approved and built by the board of construction—made up of the heads of the four bureaus—equipment, ordnance, steam engineering and construction. It was dominated by the ship building experts of the bureau of construction, the naval constructors. There were, in 1910, sixty-five of these men; there were at the same time sixteen hundred of the fighting officers.

In 1901, military officers complained to the bureaus that the turrets containing the big guns of the warships were so made as to be liable to explosions; these complaints were pigeonholed. In the next six years explosions in these turrets killed 47 men.

In 1904, military officers complained to the bureaus that the armor on our battleships was too narrow and too low. These complaints were pigeonholed. In 1908 an official examination of the fleet in the world's cruise under Admiral Evans declared this to be true.

In 1900, military officers complained to the bureaus that the freeboards of the ships were too low and the guns in their sides were so near the water that they could not be fired in an ordinary seaway. These complaints were pigeonholed. In 1908 the report from Admiral Evans' fleet showed them to be true.

In 1904, an American officer, Lieut. H. C. Poundstone, proposed the present type of fighting vessel, the so-called Dreadnought, to the bureau of construction. His suggestion was pigeonholed. In 1906 England built the first Dreadnought; and we followed her a year later. Today this is the only type of fighting battleship made.

In 1907 the bureaus warmly defended their turrets, their armor-belts, and their low guns before a congressional investigation; and, at the same time, they had requests before congress for appropriations, asking for the first of $2,000,000 which has since been spent in changing the turrets, and for money to build ships with high armor-belts, high freeboards, and high guns. The bureau system could always defend itself, but it could never produce the best tools of naval warfare.

In 1910 Secretary Meyer's reorganization had abolished the board of construction as a designer of ships, and exposed the fundamental trouble with the bureaucracy in the following comment on this organization:

"The designs submitted for the consideration of the board were almost exclusively concerned with matters which one or more of its members had previously originated or designed. Obviously, the board would be governed, in its judgment on such matters, by the technical opinion of the member who presented the case. It was a matter of approving the work of its own members."

The foregoing is a string of misrepresentation and distortion. Of the four bureaus on the Board of Construction three were under the control of line officers—the military branch—how could the one non-military member "dominate" the board. The trouble with the ships of the American navy is much more due to this very fact and that the military members never knew what they wanted or that military bureau chiefs were continually changing and bringing in different views. If the work of which the military bureaus had cognizance were done even as well with as much judgment as that of construction and repair there would be less criticism among the fighters themselves. It is well known that no two officers can be found who are in accord on the subject of design of naval ships. And after all, where is their knowledge to come from? It is pure guess-work, as we have remarked before.

The design of turrets and their mechanism is under the exclusive control of the bureau of ordnance—presided over by a military officer.

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The disposition of armor is decided by the whole board and is, of course, governed to some extent by the displacement of the ship and the permissible weight. The board appointed by President Roosevelt in 1908 to inquire into this among other things and which was almost wholly military aid did not bear out the charge. The height of the armor is a matter of entirely secondary importance with the constructors, though to be sure the question of stability, probably a deep mystery to the author, has to have consideration. In fair weather and when the ships are full of coal and stores the military men think the armor is too low; in a seaway they are perfectly certain it is too high. It can't be everywhere if the ship is to float. Reports from Admiral Evans (of immortal fame) proved nothing except that when the ships were full the armor was deep and that in a seaway the ships exposed their sides below the belt. Which condition a ship is to fight in is a question that no one is less anxious to see decided than the fighters. The same thing is true as to the guns. The bureau of ordnance is supreme in this matter.

As to the Dreadnought design the statement may be true or not; it has nothing to do with the case. The board and the naval committee have complete control; the bureau of construction could neither have adopted the suggestion nor prevented its adoption.

The statement regarding appropriations for changing turrets is true as we ourselves pointed out three years ago, but the so-called Meyer plan offers no method of avoiding a repetition;

> The plan of Secretary Meyer took the right to decide the military requirements of warship designs out of the hands of the sixty-five constructors, and placed it where the best talent and the attention of all the sixteen hundred officers in the seagoing service could be focused on it.
>
> The new organization produces the designs of ships, as follows: The general requirements of a new fightingship are laid down by the general board, which is made up of the best expert military men in the navy. These specifications are embodied in designs by the ship building experts of the bureau of construction. They are returned to the general board and the secretary of the navy, and are then considered by them together with representative officers chosen from the fleet. The general board and the secretary approve or disapprove of the officers' suggestions, and the bureau of construction works out the final plans. For the first time, the fighting ship is designed as a weapon behind which lies the entire intelligence of the whole service, sea-going and technical.
>
> The latest battleships of the navy, the Texas and the New York, were designed on this plan, and were the first battle ships ever made in the American navy that were considered and approved by the military service.

This statement, particularly in its last paragraph, is unqualifiedly false. The bureau of construction has never decided the military requirements of a warship. The procedure as outlined is exactly what it has always been, as anyone may see who will take the time to wade through departmental reports. The secretary in his 1910 report calls attention to the speed with which the designs for the New York and Texas were handled under his new "system." It is merely a bit of "business," as they say on the stage, the plans had been already prepared by the bureau of construction as shown by the secretary's own statements, though the author makes no reference to the fact.

> It was only necessary to regard the navy as a whole to come at once to the great central point of waste—the navy yards. * * *
>
> "The United States has over twice as many first-class home navy yards as Great Britain with a navy at least double the size of ours, and we have one more navy yard of the second class than Great Britain has." * * *
>
> Before Mr. Meyer came into office, two of them—those at Pensacola, Fla., and at New Orleans—had been closed, but had been reopened because it was found that they could not be legally closed without specific congressional action. Secretary Meyer, at the end of more than a year's study and inspection, has definitely advised congress to close these two yards and five other minor naval stations.

Just what we have maintained always. In fact, THE MARINE REVIEW first drew attention to the disproportionate cost of work in navy yards and the expense of their maintenance. We don't see what Meyer has done, however. Secretary Newberry did actually do something, contrary to law as it proved, and now Meyer seeks credit for recommending that congress tell him to do what Newberry did without waiting for permission. The secretary is willing to continue the Mare Island yard and build another on San Francisco bay on deeper water. He says Bremerton yard is at a disadvantage because it lacks a railroad. This puts it in the same class with the New York yard, Mare Island, Guantanamo, Pearl Harbor, and several other more or less important naval posts.

Secretary Meyer is given credit for discovering a great truth—that navy yards cannot do shipbuilding cheaply. He is probably the only man in the United States who did not know it long ago.

The secretary's report is quoted in which he claims a saving of $2,000,000 in coal in a year because of increased efficiency. Another falsification. Engineer-in-Chief Cone in the hearing before the Naval Committee* said that of this $2,000,000 about $750,000 was due to increased efficiency, the balance to decreased cruising. As will be seen by reference to the table on another page the average mileage per battleship for the year 1910 was less than one-fifth that for 1909, so that it needs no argument to prove that even Admiral Cone's estimate has no foundation. Besides this, a large part of the fuel expense for 1909 was due to the presence of the battleship fleet in the Pacific burning the gold plated Atlantic coast coal and to the large purchases of coal in foreign parts for the ships of the world-girdling fleet. It is merely another bit of stage "business," like the secretary's claim to have saved $5,000,000 in naval estimates. Not for nothing was the secretary an ambassador to Russia, a banker, etc. In the discussion on the naval appropriation bill in the House of Representatives on Feb. 21, 1911, Mr. Padgett, a member of the naval committee, said:

> I wish also to call attention to another matter. It was stated in the first part of the report that there had been a saving of $5,000,000 in the estimates submitted for the next fiscal year, as compared with the amounts appropriated for the last year. I wish to call attention to the fact that, while the amount carried in this bill is $5,929,314.14 less than the appropriations of last year, there is one fact that I wish to emphasize, and in doing that I want to call attention to the statement of Admiral Mason on page 60 of the hearing:
>
> Mr. Padgett. May I ask this question? I saw a statement in the paper the other day that there had been a saving of $5,000,000, comparing the estimates of this year and the appropriations of last year. One million eight hundred thousand dollars of it is made up of this amount that you have cut out of your estimate there because of the fact that you have not let the contracts for the ships, is it not, Admiral?
>
> Admiral Mason. I don't know on what that report of saving was based. This $1,800,000 is not a saving; it is a delayed payment.
>
> The Chairman. That really is not a saving, is it? That is to say, it simply means postponing the day of judgment!
>
> Admiral Mason. *Well, I have not reported any savings.*

In other words, because the contract for the building of the battleship New York is held up in New York navy yard and has not been awarded, they have withheld submitting in the estimates $1,800,000 that would have been

*Page 262, hearing.

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submitted if that contract had been let. So that whenever the building of the ship New York is begun this will have to be appropriated, and it is merely a postponement and not an economy.

I wish to call attention to a further fact. The total appropriations carried for increase of the navy in the present bill this year are $25,755 547.67, and the sum total for the increase of the navy in last year's appropriation was $33,770,346, or a difference of $8,014,798.33 omitted from the present bill under the item increase of the navy. Therefore, if you add to that the $1,800,000 deferred on account of the battleship New York, you have $9,814,798.33, and then if you deduct from that the difference between the present year bill and these amounts, the $5,929,316.14, you have an excess or an increase this year of $3,885,482.92. In other words, last year we appropriated to meet the authorization, and because the authorizations of last year have not been fully carried out in contract, and because of the accumulations, as shown by the testimony of the constructor, there is an unexpended balance of about $6,000,000 they are withholding, and not asking for and submitting estimates to come into the present bill and which must come in the next year's bill or in the succeeding year's bill.

If Secretary Meyer does not go down into history as a brilliant success as the head of the navy, of which there is small chance, his place is at least secure as the official Munchausen of his time. He will further be marked as the first incumbent of his high office to lend himself to the discreditable efforts of a group of line officers to secure absolute control of the department to make shore jobs for themselves and others, to cover up and misrepresent facts and to forbid that any subordinate, even a bureau chief, to dare to think other than as he himself should dictate. As to this last it is perfectly safe to say that Constructor Capps will be remembered and honored when the very name of Meyer has been forgotten.

Scotched!

Provided that no part of this appropriation shall be used to transport coal from the Atlantic to the Pacific ocean.

Twenty words incorporated in the naval appropriation bill, but it has taken many years to put them there. For 20 years, as Representative Underwood declared, the closest corporation in this country has been the combination between the Pocahontas coal interests and the navy department, and no one has ever been able to put in an entering wedge. For the past two years MARINE REVIEW has repeatedly called attention to the fact that the transportation of eastern coal to the Pacific coast for consumption in naval vessels was a reckless and unwarranted misuse of public funds. In its issue for July, 1909, it stated:

There is not only no reason why Pacific coast coal should not be, and is not, perfectly suitable to our navy for peace purposes, but there is no justification for using any other. What under the sun would a fleet on the Pacific coast do in war time? Presumably haul coal across by rail? The worst that can be said of Pacific coast coal for naval work is that it is more smoky that that bought on the Atlantic coast. It is slightly inferior in heating value, but when freight is added it will do double the work for a dollar that the eastern coal will do. The navy seems to think that it exists for itself alone and is so bound up in its etiquette and ceremonials that it has become entirely oblivious to every other interest.

The navy has resisted all attempts to break the Pocahontas monopoly and has not hesitated to use any kind of a statement in support of its attitude. About two years ago, Beekman Winthrop, acting secretary of the navy, in attempting to justify the exclusive use of Pocahontas coal, said:

The bureaus and officers who are responsible for the efficiency of our ships have uniformly taken the ground that our ships of war should use only the very highest grades of coal. The foreign ports they buy only Welsh coal from the admiralty list and in our own ports use Pocahontas and other of the New River coals which are estimated superior to the Welsh coal, the reason for this being that as a matter of fact the highest priced coal is cheaper as it contains a greater heat efficiency and the still more important fact that it is not so subject to spontaneous combustion and therefore will stand stowage in coal piles or in the bunkers of ships of war for a much longer period. The fact that the Comox and other Pacific coast coals are used by the Canadian Pacific and other ships trading on the coast where this coal is used up in a very short time, does not prove that it can be used in furnaces of ships of war.

MARINE REVIEW pointed out at the time the absurdity in that statement. Pacific coast coal is no more subject to spontaneous combustion than any other coal. In fact, not as much as Welsh coal; nor has Pocahontas coal the heating value of Welsh coal; nor does it require any special arrangement of boiler to burn western coal. The efficiency of Pocahontas is only about 6 per cent greater than that of Pacific coast coal. The Pacific coal was quite good enough for the ships of the British navy and for the great Orient liners, but the navy department continued to transport Pocahontas to the Pacific at an apalling cost. All kinds of hocus pocus was resorted to to defend its attitude and to becloud the real reason for its insistence in using Pocahontas. The debate in congress upon the subject was spirited and it was probably only respect for the memory of a man now dead that personal disclosures were not made.

The fight for fair play for Pacific interests was led by Representative Humphrey, of Washington. It was he who offered the amendment to the naval bill which opens this article. The use of Pocahontas on the Pacific involved more than the coal bill. It also involved the complete demoralization of Pacific coast shipping, as MARINE REVIEW has repeatedly pointed out. The navy department refused to transport the coal to the Pacific in American bottoms, declaring the freight rate to be excessive, though it was no more than was being paid by private citizens. To bring this about it was necessary to get an interpretation from the attorney general that the coastwise laws were not invaded. They were invaded, of course, because the government has no right to make one law for itself and another for its citizens. However, the navy department continued to carry coal to the Pacific coast in foreign bottoms and refused utterly to listen to any suggestions for amendment from American shipping interests. When they were asked to charter foreign bottoms for the round trip in order that the Pacific coast might not be deluged by this surplus of tonnage, the navy department declined to do so. The result was that these foreign vessels were let loose upon the Pacific coast to compete for any business offering. The inevitable consequence was a complete demoralization of rates and the sending into ordinary of practically every American ship on the Pacific coast. MARINE REVIEW has hitherto exhibited concretely the effect of this policy by publishing photographs of dozens of American ships lying at their moorings, unable to get employment anywhere.

However, the navy's goose in this particular is now cooked, and let us be thankful for that. Mr. Humphrey's amendment appears to have been passed practically without opposition. He led the fight well upon it. He showed that the navy department had not made any particular effort to investigate the merits of Pacific coast coal until recently and had apparently purposely delayed the report of the tests recently carried out on the Maryland and West Virginia. He had an unofficial report that the Maryland, using Pacific coast coal, had maintained a speed of 15 knots for 24 hours on a consumption of 215 tons. He doubted whether Pocahontas had ever surpassed that record. Mr. Humphrey also had some mighty interesting information to divulge concerning the test. He had been insisting all along that such a test be made and when he asked that the proper grates be inserted so that the test might be absolutely fair, the commandant of the Mare

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Island navy yard declined to recommend the installation of grate bars on the ground that it would cost $2,800. As the navy department was spending $1,000,000 annually on this coal item, the refusal to recommend the grate bars was, as Mr. Humphrey declared, stupid incompetence. Why, the Oregon used this coal in her famous trip from the Pacific ocean to the Atlantic coast; the Revenue Cutter Service uses it; the British navy uses it; all the merchant vessels use it; and the only one that objects to it is the navy department. The navy department's objection is that it makes so much smoke.

Mr. Humphrey had a spirited tilt with a number of members, but he stuck absolutely to facts and he declared that there was no excuse for the action of the navy in spending from $900,000 to $1,000,000 a year in carrying coal from the Atlantic coast to the Pacific for the use of the navy in time of peace. It was worse than a waste of public funds, for in addition to waste, it did incalculable harm to American shipping.

Mr. Underwood came to the support of Mr. Humphrey with some very pertinent remarks.

"I agree thoroughly with the proposition advanced by the gentleman from Washington," said he. *"The closest corporation in this country is the combination between the Pocahontas coal people and the navy department, and it has been so for twenty years.* I know that during the Spanish-American war, when Alabama coals, that were perfectly good for steaming purposes, were offered to the navy department for $3.25 a ton over the ship's rail at Mobile, only a night's sail from Tampa, *the navy department bought Pocahontas coal and shipped it by rail to Tampa at an expense of $9.60, and that proposition has been kept up ever since.* Now what control these particular people have over the navy department, I do not know. But I do know this, that there is no other coal field in America that can sell coal to the navy department. The supply of the navy is confined to this one field only. * * * * * I know that they have drawn millions of dollars out of the federal treasury on this coal question. There is no reason in time of peace why these Pacific coals could not be used for our navy. They are absolutely as good steaming coals as the Pocahontas. They are the same class of coals as the Alabama grades of coal, and twenty years ago, when Mr. Herbert was secretary of the navy, he sent out the battleships Montgomery and Mobile to test the Alabama coals, and the only difference between them and the Pocahontas coal was not that they did not produce as much steam power or that they did not have as great a steaming radius per ton per mile as the Pocahontas coal, but that they produced a little more smoke and clogged the flues a little sooner, a few hours sooner in a 40-hour trial. Now what have these men got to do but clean the flues? Why should the government of the United States spend millions of dollars in time of peace to relieve a captain and crew from the necessity of cleaning flues one or two hours less in 40 hours? * * * * * * * The whole proposition is this: California coal and Alabama coals have a little more volatile matter in them and a little less fixed carbon than the Pocahontas coal. That is the only difference. They produce just as much steam power, and some of them produce more steam power than the Pocahontas coal. They do produce more smoke and more dirt; but why should we ship coal at an immense expense around the Horn and across the continent to enable a few captains and ships' crews to do a little less work in handling their fuel? More than that, it is an injustice to the pople. This business of making the navy department a close corporation, bound in here between the Allegheny mountains and the Potomac river, has got to stop or you will raise a prejudice against the navy in this country that will bring more injury to it than anything else you can do. You want to build all your battleships on the eastern coast line; you want to buy all your supplies on the eastern coast line; you want all the navy yards there; you do not want the people of the United States to have any share in this navy, except in a few states. You might as well make up your mind, if you want a big navy and a navy that will be popular with the people of the United States, that you have got to stop this, and you had better stop it right now by voting for the amendment of the gentleman from Washington."

Mr. Hobson's arraignment of the navy department was quite severe. He declared that the statement from the gentleman of California as to the reason for declining to take up further experiments with Pacific coast coal was quite in line with the reasons for not making experiments in general for improving the material of the navy, *the adverse report of an officer sufficing to cut off the experiment.*

"It would have cost $2,800 to change the bars," said he. "Therefore, the officer there who, perhaps, did not wish his own account to be made higher and wishing to make a record for economy, disapproved, and the navy department accepted his disapproval as final. They did not go into it with the earnest purpose of trying to find out the full value of the coal to see if they could not improve or adopt the grate bars and other burning appliances so that Pacific coast coal could be generally used. I wish to point out at this time the steadfast inertia and impediment of the navy department in the general development of material in the navy, lo these many years. We cannot hope for better things from the department unless congress takes an interest in improvements and developments."

Mr. Pearre was inclined to oppose the amendment on the ground that he did not like to put a limitation upon the navy department that practically amounted to prohibition.

"I am not informed," said he, "whether there is collusion, as has been said here, between the secretary of the navy or the navy department and any of its officials and the operators of the West Virginia coal region. If gentlemen undertake to insinuate that, and that has been seriously insinuated here, that is a matter which should be investigated by the congress of the United States."

Mr. Wilson, of Pennsylvania, stated that the Cumberland is one of the best, if not the best, steaming coals in the world and yet Cumberland has been practically excluded by the navy department and Pocahontas has superseded it. Now why? Why the change?

Yes, and echo answers why. Mr. Sulzer also said why. "There is a reason," said Mr. Sulzer, "and the people are thinking about it and will want to know." Mr. Prince wanted to know what the reason was and Mr. Sulzer replied that Mr. Prince was a very intelligent gentleman and knew the reason just as well as he did.

"It is about time the government stop transporting ship coal for its fleet from the Atlantic to the Pacific," said Mr. Sulzer.

And to that we all say amen. There never was a sound reason for it, never a reason that would bear the light.

Humphrey may not have chopped off the monopoly's head, but he has certainly taken a little off the tail.

M. A. Hanna & Co., of Cleveland, have given contract to the Barnett & Record Co., Minneapolis, for the construction of a big storage plant for hard coal at Superior, Wis. The new shed will be of steel and concrete and will take the place of the wooden structure which was destroyed by fire last fall. It will have storage capacity of about 50,000 tons and will be operated in connection with Hanna & Co.'s soft coal dock, which has a storage capacity for about 300,000 tons. The work will cost about $60,000.

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Ore Shipments by Mines During 1910

THE remarkable record made by the Lake Superior mining districts last year, in spite of the discouraging conditions that prevailed during a considerable part of the period, is shown by the complete returns from all the iron mines, giving the ore shipments for the season, with comparisons for previous years, presented in the supplement to this issue. The total includes the mines of the Mayville district of Wisconsin, and shows that there were forwarded by lake and all-rail, 43,442,397 tons. This total does not include 115,790 tons from the Helen mine, shipped from Michipicoten harbor by the Lake Superior Corporation, and 72,470 tons from Moose Mountain mine, shipped from Key Harbor by Oglebay, Norton & Co.

Thus a new record was established, the total being greater than the shipments for 1909, the previous record year, by 855,528 tons. Shipments for 1909 exceeded those for 1907, then the record year, by 320,201 tons. Lake shipments exceeded those of 1909 by 945,159 tons, but the rail shipments were 89,631 tons less. Shipments for both 1909 and 1910 were, of course, much greater than those for 1908, when the depression in business caused a falling off in shipments for that year to 26,014,987 tons. The Marquette range reached its highest total, with 4,392,726 tons, exceeding 1909 by 136,554 tons. The great Mesabi makes another record, shipping 29,201,760 tons, which was 1,025,479 tons more than in 1909, which was a record year. The Gogebic also broke all previous records, the total, 4,315,314, exceeding that of 1909 by 227,257 tons. The Menominee range did not exceed the record of 1909, being 637,637 tons behind, with a total of 4,237,738 tons, which is the smallest for this range, with the exception of 1908, since 1904. The Vermillion range shipped 94,962 tons more than in 1909, but did not reach the tonnages of earlier years.

The United States Steel Corporation percentage was 49.86 per cent, five-tenths of 1 per cent less than last year. In other years, the Corporation has sent out as much as 56 per cent of all the ranges.

Nine mines shipped more than a million tons, the same number as in 1909, but there are a few changes: The mines in this class are Adams, Burt, Canisteo, Fayal, Hull-Rust, Mahoning, Morris, on the Mesabi, and Newport, and Norrie group on the Gogebic. The Norrie group and Canisteo for the first time appeared in the million-ton list, although Norrie was formerly among the largest mines. Canisteo is one of the Steel Corporation's washed ore properties, and will probably be a coming record breaker. The past year was the first year it had been working to any considerable extent. The famous Stevenson, of Corrigan, McKinney & Co., and the Virginia group, dropped

Shipments by Mines.

MESABI RANGE.

Adams	1,258,295	Leonard	987,910
Adriatic	135,685	Lincoln	318,912
Agnew	152,834	Mace	15,267
Albany	267,583	Maderia	83,922
Alberta	25,404	Mahoning	1,515,723
Alexander	1,652	Malta	72,035
Bangor	17,673	Mariska	23,265
Bessemer	117,173	Meadow	4,392
Biwabik	544,353	Miller	216,263
Bay	57,789	Minnewas	963
Brunt	110,630	Minorca	66,511
Burt	1,032,815	Missabi Mountain	7,226
Canisteo	1,105,160	Mississippi	36,581
Chisholm	634,236	Mohawk	123,180
Clark	529,222	Monica	69,503
Commodore	341,548	Morris	1,364,673
Corsica	277,537	Myers	131,440
Crosby	159,569	Nassau	39
Croxton	71,632	Onandaga	61,935
Cyprus	102,233	Pearce	60,411
Duluth	57,239	Pearson	78,133
Elba	186,993	Perkins	80,622
Elizabeth	7,214	Pettit	62,456
Euclid	53,009	Roberts	26,915
Fayal	1,485,099	Sauntry-Alpena	242,373
Forest	8,264	Sellers	954,042
Fowler	204,640	Seville	2,677
Franklin	31,614	Schley	13,369
Genoa	283,299	Shenango	965,148
Gilbert	110,788	Silverton	13,740
Glen	286,051	Sliver	358,432
Grant	297,761	Spring	31,909
Hanna	308,009	Spruce (Cloquet)	613,947
Harold	27,711	Stevenson	953,079
Hartley	113,512	Susquehanna	176,869
Hawkins	224,406	Sweeney	769
Hector (Hale)	82,393	Syracuse	2,363
Higgins No. 2	151,854	Troy	104,057
Hill	801,088	Uno	341,939
Holman	413,873	Utica	232,582
Hudson	168,553	Victoria	27,592
Hull-Rust	3,189,975	Virginia (Group)	985,163
Humphrey	8,227	Virginia (P. M. & Co.)	299,046
Iroquois	231,842	Wacootah	35,498
Jordan	20,314	Webb	46,384
Kellog	142,906	Wills	26,712
Kinney	401,920	Winnifred (Day)	67,686
Knox	50,942	Yawkey	30,439
LaBelle	20,349		
Larkin (Tesora)	21,700		
LaRue	128,658		
Laura	189,046		
Leetonia	615,396		

Total 29,201,760

MENOMINEE RANGE.

Antoine (Clifford)	91,081	Great Western	80,709
Aragon	241,046	Groveland	26,462
Armenia	65,473	Hemlock	115,407
Baker	39,417	Hiawatha	128,884
Baltic	171,930	Hollister	49,434
Berkshire	97,999	James	78,388
Bristol (Claire)	270,742	Lamont (Monitor)	3,183
Caspian	171,334	Loretto	116,048
Chapin (Ludington)	465,543	Mansfield	114,357
Chatham	51,988	McDonald	6,022
Common-wealth	89,116	Michigan	17,922
Dober (Riverton)	84,269	Munro	20,022
Dunn	136,144	Penn Iron M'ng. Co.	344,760
Florence	239,161	Pewabic	380,376
Fogarty	51,071	Quinnesec	744
Genesee (Ethel)	66,185	Tobin	235,812
Gibson	45,202	Tully	2,726
		Vivian	14,827
		Youngs	98,399
		Zimmerman	25,555

Total 4,237,738

GOGEBIC RANGE.

Anvil	7,235	Montreal	187,325
Ashland	231,506	Newport	1,182,324
Atlantic	79,847	Norrie Group	1,333,006
Brotherton	102,626	Ottawa (Odanah)	83,389
Cary (and Superior	205,674	Pence	8,954
Castile	20,197	Pike	3,324
Colby	194,754	Puritan (Ruby)	50,019
Eureka	41,611	Sunday Lake	115,486
Harmony (Germania)	20,080	Tilden	99,937
Iron Belt	66,627	Winona	10,500
Ironton	109,925	Yale (West Colby)	108,253
Mikado	52,715		

Total 4,315,314

MARQUETTE RANGE.

American (Sterling)	163,290	Pucy (McComber)	11,257
Austin	188,588	Maas	208,103
Beaufort (Ohio)	23,427	Mary Charlotte	197,522
Breitung Hematite	114,202	Mitchell	23,428
Cambria	150,422	Negaunee	348,818
Champion	18,746	Portland	49,584
Cleve'd-Cliffs Group	955,374	Princeton (Sw'nz'y)	89,441
Empire	53,687	Queen (Blue)	230,119
Hartford	183,471	Republic	150,732
Imperial	83,404	Richmond	95,772
Jackson	40,320	Rolling Mill	115,193
Lake Angeline	244,923	Stegmiller	48,842
Lake Superior	271,445	Stephenson	225,726
Lillie	10,121	Washington	96,769

Total 4,392,726

VERMILLION RANGE.

Pioneer	526,435	Soudan (Minn.)	75,511
Savoy	59,875	Zenith	283,320
Section 30	51,650		
Sibley	206,386		

Total 1,203,177

MISCELLANEOUS. (In Wisconsin.)

Iron Ridge	14,487	Mayville	77,195

Total 91,682

Grand total 43,442,397

SHIPMENTS BY RANGES, GROSS TONS.

	1910	1909	1908	1907	1906	1905
Marquette range	4,392,726	4,256,172	2,414,632	4,388,073	4,057,187	4,215,572
Menominee range	4,237,738	4,875,385	2,679,156	4,964,728	5,109,088	4,495,451
Gogebic range	4,315,314	4,088,057	2,699,856	3,637,102	3,643,514	3,705,207
Vermilion range	1,203,177	1,108,215	841,544	1,685,267	1,792,355	1,677,186
Mesabi range	29,201,760	28,176,281	17,257,350	27,495,708	23,819,029	20,158,699
Miscellaneous	91,682	82,759	122,449	95,790	144,589	132,001
Total	43,442,397	42,586,869	26,014,987	42,266,668	38,565,762	34,384,116

SHIPMENTS BY PORTS AND ALL-RAIL, GROSS TONS.

	1910	1909	1908	1907	1906	1905
Escanaba	4,959,726	5,747,801	3,351,502	5,761,988	5,851,050	5,307,938
Marquette	3,248,516	2,909,451	1,487,487	3,013,826	2,791,033	2,977,828
Ashland	4,094,374	3,834,207	2,513,670	3,436,867	3,388,106	3,485,344
Two Harbors	8,271,177	9,181,132	5,702,237	8,188,906	8,180,125	7,779,850
Superior	8,414,799	6,540,505	3,564,030	7,440,386	6,083,057	5,118,385
Duluth	13,640,166	13,470,503	8,808,168	13,448,736	11,220,218	8,807,559
Total by lake	42,628,758	41,683,599	25,427,094	41,288,755	37,513,589	33,475,904
Total by rail	813,639	903,270	587,893	975,959	1,052,173	907,212
Total	43,442,397	42,586,869	26,014,987	42,266,668	38,565,762	34,384,116

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out of the million ton list last year, 1910 being the first year, with the exception of 1908, since 1901 in which the Stevenson has failed to reach the million mark. Hull-Rust leads, as usual, with 3,189,975 tons, more than double that of the Mahoning, its nearest rival.

New properties are the Winona, on the Gogebic; Tully, on the Menominee; Section 30 on the Vermillion; and Bangor, Elizabeth, Harold, Hill-Hudson, Humphrey, Madeira, Meadow, Missabe Mountain, Mississippi, Schley, Silverton, Uno and Virginia on the Mesabi range. There are now two Virginias, the older being a property of the Oliver Iron Mining Co., and the new producer the property of Pickands, Mather & Co.

Annual Meeting Cleveland Cliffs Iron Co. Officials and Masters

THE annual meeting of the officials and masters of the Cleveland-Cliffs Iron Co. was held on Feb. 18. The meeting was the best that the vessel end has yet held with its men. In his address J. H. Sheadle emphasized the necessity of promoting mates, especially from the smaller boats to the larger ones whenever possible. He also thought that the mates should be shifted periodically in order to have as wide an experience as possible.

Particular attention was paid to the banking facilities which the Lake Carriers' Association is now developing and about which more will be published at a later date.

While a general shift of the mates of the fleet was made on the recommendation of the committee, only one change occurred in the line-up of captains. John Van Buskirk, who has been mate of the steamer Ishpeming for the past two years, was made master of the steamer Pioneer. The appointments were announced as follows:

Steamer.	Captain.
W. G. Mather	F. A. West
J. H. Sheadle	S. A. Lyons
Michigan	T. E. Murray
Ishpeming	C. A. Anderson
Pontiac	R. A. Gaskin
Frontenac	Charles Fox
Cadillac	H. A. Murphy
Choctaw	P. A. Anderson
Avdaste	W. T. Mooney
Pioneer	John Van Buskirk
Centurion	F. D. Perew
Peter White	S. N. Murphy
Presque Isle	James Kennedy
Angeline	J. A. Stewart

Steamer.	Mate.
W. G. Mather	W. B. Warner
J. H. Sheadle	F. D. Sullivan
Michigan	R. McNoughton
Ishpeming	B. J. Johnson
Pontiac	C. H. Burns
Frontenac	M. A. Leonard
Cadillac	Fred Detlefs
Choctaw	M. Johnson
Avdaste	G. W. McGinnis
Pioneer	Ed Maigs
Centurion	C. O. Rydholm
Peter White	W. H. Cousins
Presque Isle	George Niles
Angeline	F. W. Watson

Mr. Sheadle's address was, in part, as follows:

"Of the varied activities of the year there is no occasion more agreeable to me than the annual meeting with the masters of this company's lake fleet. Last year was the best meeting we ever had up to that time, but I expect this to be productive of even greater good. Co-operation is the order in every department of present-day business life, and co-operation is best brought about by meetings and conferences between those interested in a particular business or subject, and so it is in the operation of a lake fleet.

"I want to express my appreciation of the cordial reception and generous support which you have extended to me in my efforts in the direction of the improvement of operations of our fleet. Year by year we are getting better acquainted with each other and with the methods of doing the work, and I think all of you are coming to understand that my criticisms have never a personal nature but are made to the individual for the general good. While it happens that for the time being I guide and direct yet each and every one of you adds something each year to our general knowledge of the subject of marine navigation and to that extent have a part in the development of the fleet.

"The operations of the past year have been the best from an operating standpoint that we have ever had. The fleet is in a better condition of upkeep than it has ever been. The battle with rust has been waged very earnestly, the boats were kept in admirable condition. This is a source of much gratification to me.

"This condition, of course, did not come about without effort in which you have been giving your cordial support, and this standard can only be maintained by the same vigilance that has been exercised in the past. While I am glad to compliment you in this direction, yet I do not want any of you to think for a moment that I shall refrain from calling your attention to anything that in my judgment seems out of line the first time I visit your ships and find anything wrong.

"The improved character of the men employed on our boats last year was most noticeable—not only did we have better men on our own boats but there was a better class of men on every boat on the lakes. This is of course a direct result of the open shop policy and the operations of the Welfare Plan and Bureau of Registration of the Lake Carriers' Association.

"Some of the boats have had fewer changes in their crews than others, even though the boats compared are duplicates. This is principally due to the original selection of the crew and the effort put forth by the officers in making such selection, and then by the treatment and handling of the crew after it is selected.

"When there are changes in the crew the master should make inquiry of the mate as to the reason for a given man leaving the ship, and make a record of the reason so assigned. There may be reasons which lie with the ship's officers or with the ship itself, and if it is found there are defects in either direction they should be given cognizance.

"I am watching our ships' officers to see how they handle this matter of crew, and I wish to say to you that that man who makes the fewest changes in his crew during a given season is making the best record as a handler of men.

"While speaking on the question of men I want to again impress upon you what I have said many times before, that it is the duty of every one in charge of men, which in this case is the duty of the master and the other officers of the ship, to know something about every man in their charge. Many a man can be aided and helped to better things, which will not only result in greater usefulness to himself but greater usefulness to his employer. Always learn something of the antecedents and hopes of your men if you can.

"It is desirable, that we should apply in our individual way the principles that underlie the workings of the Lake Carriers' Association Welfare Plan. We should on shipboard do what we can to aid the men to more knowledge. A man should be encouraged to read —encouraged in any direction for good. If he has a notion of making marine work his life work, aid him in every way to develop himself towards reaching forward to greater usefulness in the higher departments of the work.

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"The appearance of the officers and men on our ships was a frequent matter of favorable comment last season by those who had a chance to observe them, for the officers were usually clean-shaven, and nearly always tidy, but then this is to be expected with us because it has become the habit in our fleet. Indeed it would be very discouraging if we did not receive such favorable comment after our long years in working along these lines.

Personal Injury on Ships.

"The question of personal injuries and fatal accidents in all public work is being industriously and deeply studied by people everywhere. Much thought is being given same in this and other countries in an endeavor to mitigate these injuries and materially reduce accidents which result in the loss of life.

"I have spoken in a general way about personal injuries before, but I want to make a stronger point on this feature of our work than ever.

"I think that the most expedient way to proceed in this matter will be to appoint a committee, which will by the opening of navigation make such suggestions as seem valuable in the way of providing safeguards and preventing accidents.

"For each individual ship I desire that a committee be formed when the ship starts out in the spring, consisting of the master, first mate and chief engineer, of which the master shall be the chairman and the mate the secretary. This committee shall be known on board ship as the committee of safety, and shall study from their own standpoint the question of prevention of accident on board each respective boat.

"I think that some of these accidents, if indeed not all of them, can be prevented by a systematic educational campaign. I mean by this an observance of such items as the following:

"Never allow the use of a defective ladder anywhere.

"Never allow the engine room gangplank to be put out except for the handling of freight.

"See that sufficient lights are placed at night around the hatches when working.

"See that there is a pipe railing erected forward of No. 1 hatch and at the after side of the after hatch where same come close to the house.

"See that a light is always placed on deck at the mooring cables.

"I would call particular attention to the danger of leaving any hatches uncovered at night when the boat is not working.

"When staging is used, either outside the hull or in the hold, care must be used to see that good sized planks are used, and that not less than a 2½-inch line is used, never permitting the use of a heaving line for such purpose.

"When new men are shipped they should be asked what they know about the work on a ship and the handling of lines. The mate should instruct them how to handle lines in the windlass room and aft. Many a man has been injured by putting his foot on a line in an effort to stop it after it had begun to run out.

Crew Saving Money.

"I have thought for several years that some plan—some machinery—should be put in operation that will enable the sailor to find it convenient to save his money by depositing it in a savings bank.

"While the statement is threadbare it is never-the-less true that the man with a sum of money saved up, no matter how small, is a better man in every way than the man who has not a dollar to his name.

"The sailor on the great lakes by reason of his frequent touching at port has had the opportunity of opening a bank account did he choose to do so, but it takes something more than the bare fact that there is such a thing as a bank to start many men in the way of saving money.

"One of our captains told me several years ago about a steward he had ten years ago, who never had a bank account until induced to start one by the master in question—that he had encouraged this steward to open an account in a bank, and that the last he heard of him, a year or so ago, the account had grown to several thousand dollars, simply because he had made a start and got the habit.

"There is scarcely a boat in our fleet, or a boat sailing these lakes, of which the master or other officer is not the custodian of sums of money left with him by the different members of the crew from time to time. It therefore seems that some plan should be devised that will enable the men to reach a bank conveniently with their surplus money.

"Some such plan is now being thought out by the Lake Carriers' Association for general application to all lake boats and same will be presented to you at the opening of navigation. At first it will undoubtedly be found that the machinery of performing the work will have to be changed or improved; there will perhaps not be very enthusiastic encouragement at the beginning, as is the case with all new things; however, we have made such rapid progress in the development of other lines of improvement of men, that with your hearty co-operation I believe very substantial progress will be found to have been made in this direction by the end of the season.

"I shall, therefore, ask that the officers of this fleet put forth special efforts to encourage the men to make use of whatever plan for saving money that may be presented and to aid in every way the inculcation of the habit of saving. Indeed, if the ships' officers will as soon as possible themselves make use of the facilities for banking that will be provided the example will be beneficial.

Conference of Ship's Officers.

"I specially desire that on the opening of the season each master hold a conference of what shall be called the ship's committee, at which will be present the mates, the chief and assistant engineers, in other words, all the licensed officers, and that matters be gone over in a manner similar to that which we employ in this meeting. The master shall be the chairman and the mate the secretary. The secretary will write a report of the different points discussed for transmission to the office.

"It will be incumbent on the master to think over the matters that should be given attention. The success of such meetings will largely depend upon the interest the master takes in them. If you do nothing more than bring out emphatically some of the salient points that are developed at this meeting you will have accomplished much.

"There are, however, an endless number of details that can be taken up at such meetings and talked over in the presence of the men with great benefit. Indeed, I would like to see six of such meetings held during the season of navigation, at which the aforementioned men will confer. The master and chief engineer will have an opportunity to express their views on general matters in their respective departments, which in turn, will make for the good of the whole.

"I think you will find that in some such procedure as this you will establish a cohesion in your crew such as you have never had before. We have had a great improvement from these masters' meetings that we have

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held—why not extend the benefit of the idea to each individual ship?

Mates.

"One matter that is always important is the selection of the mates. I have explained to you before my thought that a mate should not remain too long with one particular master, but should be shifted about, so that when there comes to be a selection of a mate for a master's position there will be the judgment of more than one master regarding his qualifications.

"Especially is it fair that the mates on the smaller boats should have preferment and be given place on the larger boats when the master of one of the large boats desires a mate. It is not fair if one of the smaller boats has a particularly good man that he be held on that boat while the master of one of the larger boats goes out and secures a mate elsewhere. It is not in the line of promotion, and this feature is one that I wish to specially direct to your attention.

"Last year a committee was appointed on the subject of prizes for mates. While it is not practicable to adopt, at this time, the full report, yet I feel the time has come for some start in this direction. I have therefore decided on a plan of prizes, the boats to be divided into two classes, 'A' and 'B.'

"The particular items upon which the awarding of these prizes are to be based to be as follows:

"General appearance of ship outside during running season.

"General order and condition of equipment.

"Degree of absence of rust in every part of the ship.

"General discipline.

"Changes on crew during season.

"Amount of scraping and painting to be done when ship comes in at the end of the season.

"The prizes shall be: Class 'A,' 1st $75, 2nd $45; Class 'B,' 1st $50, 2nd $30.

"In order to stimulate the mates to further interest in their work, I desire that each mate prepare himself during the season to write a communication, setting forth his ideas regarding the various items pertaining to the operation of a ship, in which he will dwell upon any items of navigation that may occur to him, his notions and thoughts in regard to the selection of men, the performing of work, in fact anything that may come to his mind, especially those items pertaining to the economical manner of doing work and the purchasing of supplies.

"Every mate who remains during the season will be asked to write such a letter; the communications will be submitted to competent judges at the end of the season who will pass upon them as to their merit. A first prize of $50 will be awarded, a second prize of $35 and a third of $20. I will personally give these prizes."

Pittsburgh Steamship Co. Buys the Mills Boats

The Pittsburgh Steamship Co. purchased the three steamers L. S. DeGraff, William M. Mills and W. B. Kerr from the Weston Transit Co. of Tonawanda, N. Y., of which W. H. Mills is manager. These three vessels, which came out in 1907, are the largest on the lakes, being 605 ft. over all, 585 ft. keel, 60 ft. beam and 32 ft. deep. In consonance with the policy of naming the vessels of the Pittsburgh Steamship Co.'s fleet after men prominent in the Steel Corporation or its subsidiary companies, Mr. Coulby, president and general manager of the company, has renamed the vessels. The William B. Kerr has been renamed in honor of Francis E. House of Duluth, president of the Duluth & Iron Range Railroad; the L. S. DeGraff has been renamed in honor of George G. Crawford of Birmingham, Ala., president of the Tennessee Coal & Iron Railroad Co., and the W. M. Mills has been renamed in honor of William J. Filbert of New York, comptroller of the United States Steel Corporation.

Much satisfaction is expressed in the trade over this purchase. The independent vessel owners are extremely glad to have the vessels thus eliminated from the wild market. The purchase of the vessels is in effect a subtraction from the independent tonnage and strengthens the independent interest to that extent. The Pittsburgh Steamship Co. had intended to build two vessels, having been authorized by the Steel Corporation to do so early in the winter, but the purchase will of course delay the building program for the time being.

Improving Dock Equipment

The present winter has been marked by considerable activity on the part of the railways in improving dock equipment and extending their water front facilities. During the past year the Pennsylvania system has been quietly filling in the west breakwater to the harbor line at Cleveland and while as yet there is little to show for what they have done, an enormous quantity of material nevertheless has been dumped into the water. It is expected that the work will be sufficiently advanced by spring to begin the construction of a concrete ore dock to be equipped with unloading machinery of the most modern type.

The Erie railway too, has greatly enlarged its ore handling facilities during the year, including the erection at Randall of a storage yard covering an area of about 15 acres and providing practically unlimited storage capacity. It has erected at Randall a modern movable car dump of the Wellman-Seaver-Morgan type with an unloading capacity of 15,000 tons per day and a 10-ton ore bridge, electrically operated.

It has also increased its coal loading facilities by the erection of an improved coal dump of the Wellman-Seaver-Morgan type on the west bank of the Cuyahoga river near the Center street bridge. This dump will be operated by the Pittsburg Coal Co. and has a capacity of 15,000 tons per day. Concerning these improvements H. E. Gilpin, general agent, has sent a circular to the trade saying:

"Viewing the past with the present and with an eye to the future growth of Cleveland and the city's commercial importance as a Lake Erie port, especially in the movement of the vast iron ore and coal tonnage to and from the Lake Superior ore beds and the coal mines of Pennsylvania and Ohio, the Erie Railroad Co. has, during the past year, greatly improved and enlarged its ore handling facilities, and has under construction the most modern and complete coal dumping machine on the great lakes.

"The ore docks of the Erie Railroad Co. are operated by the N. Y., P. & O. Dock Co., for whom Pickands Mather & Co., of Cleveland, are the agents, are located on what is known as the old river bed, practically at the harbor entrance, the mouth of the Cuyahoga river, have a dock frontage of 2,700 ft., and are equipped with four Brown electrically operated 5-ton, and with five Hoover & Mason steam operated 5-ton fast unloaders, having a maximum total unloading capacity of 30,000 tons per day.

"The rail and yard facilities are sufficient to afford the most prompt unloading from vessels, and the movement of ore by the shortest and most direct route from Cleveland to the great iron and steel centers at Pittsburg, Youngstown, Sharon and other

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places throughout the entire Shenango and Mahoning valleys.

"Additional and improved engines and car equipment insure quick dispatch from vessel to furnace, and by the erection at Randall, a suburb of Cleveland, of a modern movable car dump of the Wellman-Seaver-Morgan type, with an unloading capacity of 15,000 tons per day of ten hours, and a Heyl & Patterson 10-ton ore bridge, electrically operated, and covering an area of about 15 acres, provides storage facilities for a practically unlimited quantity of ore, and its immediate forwarding to destination when required.

"The Erie railroad management takes pleasure in calling attention to these improved methods of handling both the iron ore and lake coal shipments, realizing, as it does, the necessity for quick loading and unloading of vessels when at dock, which means so much to the lake carrier.

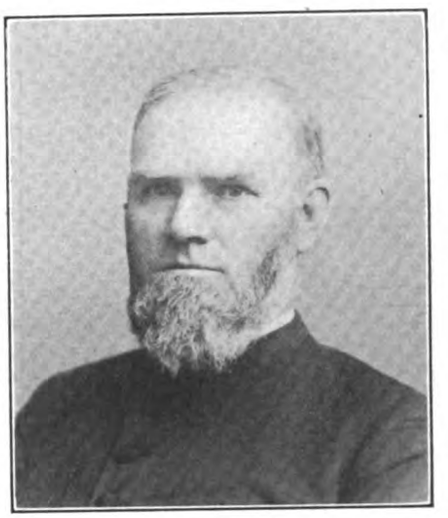
"The new improved coal dump, constructed by the Wellman-Seaver-Morgan Co., will be completed and ready for service by the opening of navigation this coming season, is located just south of the Center street bridge, on the west bank of the Cuyahoga river, and has a capacity of 15,000 tons per day, with a dock frontage of 3,000 ft., and with the contemplated improvement in the harbor and river, will afford free and easy access, both to the ore and the coal docks, by the largest boats navigating the great lakes.

"Cleveland is essentially an ideal harbor, is clearly the lake port of that industrial and mining territory of which Pittsburg is the center, and the Erie Railroad, in developing its railroad and terminal facilities at Cleveland, is meeting the present demand and future requirements of its lake shipping patrons for prompt loading and unloading of vessels."

Death of Robert Wallace

The news from St. Petersburg, Fla., that Robert Wallace had died there on Tuesday morning, Mar. 7, will be read with profound regret along the whole chain of lakes. During the last few years, Mr. Wallace had been in the habit of spending a fair part of each winter in Florida, fishing, of which sport he was extremely fond. He took an immense enjoyment in these southern vacations, which were the brief rewards of a lifetime of hard work. His death was directly due to heart failure. He was recovering, gradually but surely, from an attack of intestinal poisoning, but the struggle at his advanced age had so weakened him that his heart suddenly failed him.

Robert Wallace was a fine example of the self-made man. He came to this country at the age of 20 from his home in Cootehill, Ireland, and settled almost immediately in Cleveland. He obtained employment in a small machine shop. He gradually accumulated sufficient funds to buy with John F. Pankhurst,



ROBERT WALLACE.

Henry D. Coffinberry and John B. Cowle a small machine shop in the flats of Cleveland. This small shop was later developed into the Globe Iron Works, and when an interest was subsequently purchased in a dry dock building by the firm of Stevens & Presley, the Globe Iron Works naturally gravitated into the ship building business. At that time, of course, practically the entire commerce of the lakes was carried in small wooden schooners. As the business developed, however, the type of bulk freight carrier was evolved. The business of the Globe Iron Works grew with the trade and the Globe was the first to build an ore-carrying steamer of iron. This was the Onoko, constructed in 1882. From that time onward, the change from wood to iron and steel was rapid. It was right at this juncture that internal differences resulted in the withdrawal of Mr. Wallace and his associates from the Globe Iron Works, leaving the Globe in the hands of Mr. Pankhurst. Mr. Wallace then formed the Cleveland Ship Building Co., building a yard in Cleveland, and later on at the new port of Lorain. In 1899, both the Globe Iron Works and the Cleveland Ship Building Co. were taken over by the American Ship Building Co. In the organization of this combination, Mr. Wallace was a potent factor, and his son, James C. Wallace, was made general manager of the combined yards. Since that time, Mr. Wallace had gradually withdrawn from active employment, being content to leave the management to his son, James.

Robert Wallace was born on May 17, 1834, and was, therefore, in his 76th year. He leaves a widow, three sons and two daughters. His sons are all connected with the American Ship Building Co., James C. Wallace as president, Robert B. Wallace as general manager, and Lindsay H. Wallace as assistant manager of the Cleveland and Lorain yards.

Obituary

John Corrigan, formerly in the vessel business on the lakes, was instantly killed in an automobile accident at Los Angeles, Cal., on March 1. He was a brother of the late James Corrigan, who was one of the boldest operators on the Lake Superior iron ranges. John Corrigan was at one time president and treasurer of the Aurania Transit Co., vice president of the Australia Transit Co., and a director in the Lake County Transportation Co. Latterly he has been living on his farm at Perry, O.

The Earl of Cawdor, first lord of the British admiralty under the Balfour administration, died on Feb. 9. He succeeded the Earl of Glasgow as the president of the Institution of Naval Architects. He was the projector of the Cawdor program of naval construction under which four ships of the Dreadnought type were to be constructed annually.

John E. Payne, president of the Erie & Western Transportation Co., operating the Anchor Line of steamers on the great lakes, died at Philadelphia on Feb. 13 at the age of sixty-eight years.

William H. Corbett, president of the Willamette Iron & Steel Works, Portland, Ore., died on Feb. 20.

Work upon the Livingstone channel at the mouth of the lower Detroit river, which has been suspended owing to opposition on the part of the citizens of Amherstburg to the construction of a dyke, has been resumed upon orders from the War Department at Washington. As the work is in Canadian waters the protest of the citizens of Amherstburg had to be passed upon by the Dominion government and it must be said that the Dominion government was slow enough in passing upon it. The delay has been costly and serious, as the working force naturally had been dismissed and the contractors, tired of waiting, had removed part of their equipment to other fields of activity.

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Steamer Suwanee Launched

The New York Ship Building Co., Camden, N. J., launched on Feb. 25 the steamer Suwanee, building for the Merchants' & Miners' Transportation Co. She was launched with all machinery aboard, and practically complete, except funnel and spars. The Suwanee is 333 ft. long, 46 ft. beam and 18 ft. load draught. She has triple-expansion engines and Scotch boilers. The steamer is intended for the Savannah-Jacksonville route.

LAUNCHING THE STEAMER SUWANEE AT THE YARD OF THE NEW YORK SHIP BUILDING CO., CAMDEN, N. J.

Ship Yard Notes

The Fore River Ship Building Co., Quincy, Mass., launched on Feb. 2 the passenger and freight steamer Sankaty for the New Bedford, Martha's Vineyard & Nantucket Steamboat Co. She is intended for all-year service between New Bedford and Nantucket. The Sankaty is a single screw steamer built to the highest class of the American bureau of shipping and is 195 ft. long, 38 ft. 2 in. beam and 12 ft. 6 in. deep. She has triple-expansion engines and Almy water-tube boilers.

A. C. Brown, Tottenville, L. I., has been awarded contract to build a schooner for Dr. W. I. Greenfell in connection with the work of the Labrador mission. The new vessel will be 135 ft. long, 26 ft. beam and 12 ft. deep and will be equipped with a 75-H. P. kerosene oil engine. The vessel will be named in honor of George B. Cluett, whose gift to the mission she is.

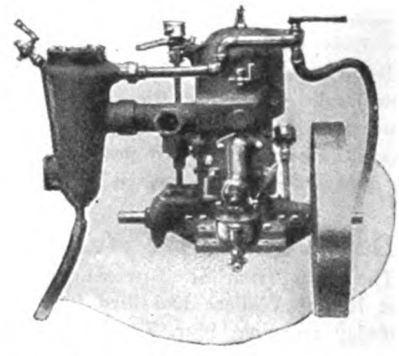
The Bath Iron Works, Bath, Me., launched the twin-screw steamer Moosehead, which it is building for the Maine Central railroad to operate between Rockland and Bar Harbor. The Moosehead is 185 ft. long, 30½ ft. beam and 14½ ft. deep.

The Fore River Ship Building Co., Quincy, Mass., was awarded contract by the New England Coal & Coke Co. of Boston, for a steel collier to be 389 ft. long, 54½ ft. beam and 31 ft. deep, of 7,200 tons carrying capacity.

The Newport News Ship Building & Dry Dock Co., Newport News, Va., has laid the keel for a new steamer for A. H. Bull & Co., of New York.

Hydrex Silencer

For some years past a campaign has been waged against unnecessary noises, especially so in New York city. Steam whistling has been reduced to a minimum and now motor boats on the Hudson river have been required to muffle their exhaust. One of the new devices to achieve this end, the Hydrex silencer, has just been put on the market. To exhaust gas without heat means to exhaust it without pressure and therefore without noise and that is the object which the Hydrex silencer achieves. Gradually with increasing expansion the gases are led out from the cylinders and as gradually and completely relieved of their heat by an even admixture with cold water vapor until when exhausted through an opening in the boat's side above water the noise can scarcely be heard a cable's length off. The device is simple and easy to install and is adapted to any size and type of motor. It can be placed forward, aft or athwartships and can be discharged at any convenient place, though preferably at the stern. The device is manufactured by the Hydrex Silent Exhaust Works, 126 Liberty street, New York.



The Atlantic Works, Inc., Twenty-eighth street and Gray's Ferry road, Philadelphia, Pa., recently sold one of their bevel band saw machines to Henry Brusser, Weems, Va.

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